

Dying in hospital with high-grade glioma: symptom burden, end-of-life care quality, and a compressed transition to comfort-focused medication

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Abstract

Purpose Indicators of end-of-life care quality in oncology derive largely from systemic cancer, in which patients can report symptoms and share decisions until close to death. High-grade glioma differs. We characterised the terminal hospital admission in this population, focusing on symptom burden, functional status and the change in medication use across the admission.

Methods Retrospective cohort of consecutive adults with CNS WHO grade 3–4 glioma admitted to a Polish university hospital palliative medicine department, 2020–2025. Variables were abstracted from medical records. Time to in-hospital death was estimated by the Kaplan–Meier method, censoring at discharge.

Results Thirty-one patients were analysed (mean age 62.4 ± 13.2 years; 58.1% women; 83.9% CNS WHO grade 4). Twenty-nine (93.5%) were admitted acutely from an emergency department or another ward and two (6.5%) from hospice. Twenty-six (83.9%) had ECOG performance status 3–4 and Karnofsky $\leq 50\%$. Commonest symptoms were limb weakness (51.6%), seizures (45.2%) and impaired consciousness (41.9%); 77.4% had impaired consciousness, dysphasia or disorientation on arrival, precluding self-report. Corticosteroid use fell from 87.1% before admission to 61.3% during it and antiepileptic use from 64.5% to 41.9%, while opioid use rose from 19.4% to 41.9% and benzodiazepine use from 3.2% to 25.8%. Twenty-one patients (67.7%) died in hospital; median time to in-hospital death was 28 days and family were present at 19.0% of deaths.

Conclusion The terminal admission compresses into days a transition to comfort-focused care that should occur earlier and in the community. Functional decline should trigger palliative referral, and anticipatory prescribing should be specified in neurologically appropriate terms.

INTRODUCTION

The quality of end-of-life care in oncology is now judged against a set of widely adopted indicators: avoidance of chemotherapy and of crisis hospital use in the final weeks, timely hospice enrolment, and death outside an acute-care institution [1]. These indicators were derived from, and validated in, populations dying of systemic cancer, in which the terminal trajectory is dominated by pain, dyspnoea, fatigue and cachexia, and in which patients usually retain the capacity to report symptoms and to participate in decisions until close to death.

High-grade glioma fits this template poorly. It accounts for a substantial share of malignant primary brain tumours, and despite maximal safe resection, radiotherapy and temozolomide, median overall survival remains between 12 and 18 months [2, 3, 4, 5]. Its terminal phase is neurological rather than somatic: progressive focal deficits, seizures, declining consciousness and early loss of decision-making capacity dominate the final weeks, while classical somatic symptom burden is comparatively modest [6, 7, 8]. Two consequences follow for supportive care. Self-report instruments become unusable at

precisely the point when symptom control matters most, and the window for advance care planning closes earlier than clinicians expect.

These features are recognised in guidance. The European Association of Neuro-Oncology palliative care guideline and subsequent reviews recommend early palliative integration, anticipatory prescribing and timely goals-of-care discussion [9, 10, 11, 12]. Population-level data suggest the recommendations are unevenly realised: in a cohort of 9,013 patients with glioblastoma, in-hospital death remained common and disease-directed treatment near death increased over time [13], and other registry analyses document persistent emergency department use and late hospice enrolment [14, 15, 16].

What is rarely described is the admission itself – the hospitalisation from which most of these patients do not return home. This admission is where a delayed community transition becomes concrete and measurable: which symptoms are present on arrival, what functional reserve remains, which drugs are started and which are stopped, and how quickly death follows. We therefore characterised consecutive adults with CNS WHO grade 3–4 glioma admitted to a palliative medicine department during their terminal admission. Our aims were to describe symptom burden, functional status and laboratory findings; to quantify the change in medication use across the admission as a marker of the timing of the transition to comfort-focused care; and to set these observations against established indicators of end-of-life care quality.

METHODS

Study design and setting

This was a retrospective observational cohort study conducted at the University Hospital in Krakow, Poland, across the Department of Palliative Medicine and the Department of Neurosurgery and Neurotraumatology. The study is reported in accordance with the STROBE statement for observational research; the completed checklist is provided as Supplementary Material.

Participants

We reviewed consecutive adults (≥ 18 years) with a histopathologically confirmed diffuse glioma admitted to the Department of Palliative Medicine between January 2020 and December 2025. Patients were admitted directly from the emergency department, transferred from another hospital ward, or admitted from inpatient or home hospice care. Of 36 patients screened, 31 met the inclusion criterion of CNS WHO grade 3 or 4 disease and constituted the analysis cohort; two patients with WHO grade 2 tumours and three in whom histological grade could not be established (including one non-diagnostic biopsy) were excluded. Tumours were classified according to the WHO Classification of Tumours of the Central Nervous System in force at the time of diagnosis. Because the cohort spans the transition to the 2021 classification, and because molecular data were not uniformly available in patients diagnosed

before 2021, we analysed grade 3 and grade 4 tumours together as high-grade glioma rather than restricting the cohort to molecularly defined glioblastoma [17].

Variables

Data were abstracted from electronic and paper records using a standardised protocol. Recorded variables were: demographics; histological diagnosis and WHO grade; tumour laterality and lobar involvement; prior and ongoing resection, radiotherapy and chemotherapy; source of admission and documented community or hospice support before admission; Eastern Cooperative Oncology Group (ECOG) performance status, Karnofsky Performance Status (KPS) and the Charlson Comorbidity Index at admission; neurological and systemic symptoms at admission and during the admission; laboratory results; medications in use before admission and administered during the admission; and, for patients who died, the mode of death and whether family were present.

Symptoms were those documented by the treating team; no structured patient-reported instrument was in routine use, and findings not recorded in the chart were treated as absent. Medication was recorded at the level of drug class, as use versus non-use in each period, without dose or route. Laboratory variables were serum albumin, glucose, lactate dehydrogenase (LDH), potassium, sodium, calcium, white blood cell count and haemoglobin, taken at the first and the last measurement during the admission. Values obtained in the referring unit before transfer were not analysed, because they were available in fewer than one third of patients. C-reactive protein was not recorded consistently and was not analysed.

Outcomes

The primary outcome was time from admission to in-hospital death. Secondary outcomes were the frequency of symptoms at admission and during the admission, functional status at admission, laboratory abnormalities, and the change in medication use between the pre-admission and in-hospital periods.

Statistical analysis

Continuous variables are summarised as mean $\pm$ standard deviation or as median with interquartile range (IQR), according to distribution; categorical variables as counts and percentages. Denominators are stated wherever data were missing, and no imputation was performed. Time to in-hospital death was estimated by the Kaplan–Meier method for the whole cohort, with patients discharged alive censored at discharge; 95% confidence intervals (CI) were derived using Greenwood's formula. Given the sample size and the descriptive aim of the study, no hypothesis testing or multivariable modelling was undertaken. Analyses were performed in Python 3.11 (pandas, NumPy, Matplotlib) and verified in STATISTICA v.13.0 (StatSoft, Poland).

Ethics

The study was approved by the Bioethics Committee of Jagiellonian University Medical College. Its retrospective design and the use of anonymised data qualified it for a waiver of informed consent.

RESULTS

Cohort and admission pathway

Thirty-one patients were analysed (Table 1). Mean age was 62.4 ± 13.2 years (median 65, range 26–89) and 18 patients (58.1%) were women. Twenty-six tumours (83.9%) were CNS WHO grade 4 – 21 glioblastoma, three gliosarcoma and two grade 4 astrocytoma – and five (16.1%) were grade 3. Twenty-nine patients (93.5%) had undergone prior resection or biopsy, 21 (67.7%) prior radiotherapy and 18 (58.1%) prior chemotherapy; disease-directed treatment was still ongoing in seven patients (22.6%) at admission.

Table 1

Clinical, tumour and treatment characteristics of the cohort (n = 31). Values are n (%) unless stated otherwise.

Variable	Value
Age, years, mean $\pm$ SD	62.4 $\pm$ 13.2
Age, years, median (range)	65 (26–89)
Female sex	18 (58.1)
<i>Histological diagnosis</i>	
Glioblastoma	21 (67.7)
Astrocytoma	4 (12.9)
Gliosarcoma	3 (9.7)
Oligodendroglioma	2 (6.5)
Oligoastrocytoma	1 (3.2)
<i>CNS WHO grade</i>	
Grade 4	26 (83.9)
Grade 3	5 (16.1)
<i>Tumour laterality</i>	
Left	17 (54.8)
Right	12 (38.7)
Bilateral	2 (6.5)
<i>Lobar involvement[‡]</i>	
Frontal	16 (51.6)
Temporal	16 (51.6)
Parietal	12 (38.7)
Occipital	2 (6.5)
<i>Number of lobes involved[‡]</i>	
[‡] Lobar data were unavailable in one patient; percentages are of the whole cohort. Tumours involving more than one lobe are counted in each lobe.	
[‡] Pre-admission care arrangements were documented in 25 of 31 patients.	
[‡] Available in 30 of 31 patients.	
ECOG Eastern Cooperative Oncology Group; IQR interquartile range; SD standard deviation.	

Variable	Value
One	17 (54.8)
Two	10 (32.3)
Three	3 (9.7)
<i>Treatment history</i>	
Prior resection or biopsy	29 (93.5)
Prior radiotherapy	21 (67.7)
Prior chemotherapy	18 (58.1)
Disease-directed treatment ongoing at admission	7 (22.6)
<i>Source of admission</i>	
Another hospital ward	15 (48.4)
Emergency department	14 (45.2)
Inpatient hospice	1 (3.2)
Home hospice	1 (3.2)
Community or hospice support before admission [‡]	14/25 (56.0)
<i>Functional status at admission</i>	
ECOG performance status 1	2 (6.5)
ECOG performance status 2	3 (9.7)
ECOG performance status 3	5 (16.1)
ECOG performance status 4	21 (67.7)
Karnofsky Performance Status $\leq$ 50%	26 (83.9)
Karnofsky Performance Status $\leq$ 30%	20 (64.5)
Charlson Comorbidity Index, median (IQR) [§]	4 (3–5)
[‡] Lobar data were unavailable in one patient; percentages are of the whole cohort. Tumours involving more than one lobe are counted in each lobe.	
[§] Pre-admission care arrangements were documented in 25 of 31 patients.	
[§] Available in 30 of 31 patients.	
ECOG Eastern Cooperative Oncology Group; IQR interquartile range; SD standard deviation.	

The admission was acute in 29 of 31 patients (93.5%): 14 (45.2%) came from the emergency department and 15 (48.4%) were transferred from another hospital ward. Only two patients (6.5%) were admitted from hospice care. Thirty patients (96.8%) were admitted for symptom control or for management of a deteriorating general condition; one was admitted for stereotactic radiotherapy. Among the 25 patients in whom pre-admission arrangements were documented, 14 (56.0%) had some form of hospice or organised family care in place and 11 (44.0%) had none.

Functional status and symptom burden

Functional status at admission was poor (Fig. 1A, B). Twenty-six patients (83.9%) had ECOG performance status 3 or 4, and the same proportion had a KPS of 50% or below; 20 patients (64.5%) had a KPS of 30% or below. The general condition was documented as severe in 15 patients (48.4%) and as moderately severe in nine (29.0%). The median Charlson Comorbidity Index was 4 (IQR 3–5).

Neurological symptoms dominated the presentation (Fig. 1C). The most frequent were limb weakness in 16 patients (51.6%), seizures in 14 (45.2%), impaired consciousness in 13 (41.9%), speech impairment in 10 (32.3%) and disorientation in nine (29.0%). A positive Babinski reflex was present in six patients (19.4%). Systemic symptoms were comparatively uncommon: dyspnoea, nausea or vomiting and infection were each documented in two or three patients (6.5–9.7%), fever and meningeal signs in one each (3.2%). Taken together, impaired consciousness, speech impairment or disorientation was present in 24 patients (77.4%) at admission.

During the admission the pattern shifted (Table 2). Oedema was recorded in 20 patients (64.5%), dyspnoea in 10 (32.3%) and restlessness or non-verbal signs of distress in 11 (35.5%). Nine patients (29.0%) developed pressure ulcers. Seizures were documented in only two patients (6.5%) after admission, and healthcare-associated infection in one (3.2%).

Table 2

Clinical course, medication and outcome of the terminal admission (n = 31). Values are n (%) unless stated otherwise. Findings not recorded in the chart were treated as absent.

Variable	Before admission	During admission
<i>General condition at admission</i>		
Moderate	7 (22.6)	—
Moderately severe	9 (29.0)	—
Severe	15 (48.4)	—
<i>Clinical events during admission</i>		
Oedema	—	20 (64.5)
Restlessness or non-verbal signs of distress	—	11 (35.5)
Dyspnoea	—	10 (32.3)
Pressure ulcers	—	9 (29.0)
Constipation	—	4 (12.9)
Fever	—	3 (9.7)
Seizures	—	2 (6.5)
Healthcare-associated infection	—	1 (3.2)
<i>Medication</i>		
Corticosteroids	27 (87.1)	19 (61.3)
Antiepileptic drugs	20 (64.5)	13 (41.9)
Opioids	6 (19.4)	13 (41.9)
Benzodiazepines	1 (3.2)	8 (25.8)
Non-steroidal anti-inflammatory drugs	5 (16.1)	14 (45.2)
Antidepressants	6 (19.4)	8 (25.8)
Antipsychotics	6 (19.4)	4 (12.9)
<i>Supportive interventions</i>		
Oxygen	—	13 (41.9)
Intravenous fluids	—	13 (41.9)
Dashes indicate that the variable was not applicable to that period.		
IQR interquartile range.		

Variable	Before admission	During admission
Mannitol	—	11 (35.5)
Urinary catheter	—	8 (25.8)
<i>Outcome</i>		
Died during the index admission	—	21 (67.7)
Discharged alive	—	10 (32.3)
Length of stay, days, median (IQR)	—	16 (6–32)
<i>Circumstances of death (n = 21)</i>		
Gradual cessation of vital functions	—	20 (95.2)
Sudden cardiorespiratory failure	—	1 (4.8)
Family present at the moment of death	—	4 (19.0)
Dashes indicate that the variable was not applicable to that period.		
IQR interquartile range.		

Laboratory findings

Laboratory abnormalities were present but generally mild (Table 3). At the first in-hospital measurement, albumin was below 35 g/L in 10 of 27 patients (37.0%), haemoglobin below 12 g/dL in nine of 23 (39.1%), and white blood cell count above $11 \times 10^9/\text{L}$ in seven of 23 (30.4%). LDH was above 250 U/L in 14 of 23 patients (60.9%), the most consistently abnormal parameter. Sodium was below 135 mmol/L in five of 27 patients (18.5%). Between the first and last measurement the proportion with hypoalbuminaemia rose from 37.0% to 43.8% and the proportion with elevated LDH from 60.9% to 76.9%, while haemoglobin, sodium, potassium and calcium changed little.

Table 3

Laboratory results at the first and last measurement during the admission. n denotes the number of patients in whom the parameter was measured; percentages are of that number.

Parameter	n	Mean $\pm$ SD	Median (range)	Threshold	Abnormal, n (%)
<i>First measurement during admission</i>					
Albumin, g/L	27	36.1 $\pm$ 5.6	37.4 (27.0–47.6)	< 35	10 (37.0)
Haemoglobin, g/dL	23	12.9 $\pm$ 1.8	13.1 (10.0–16.8)	< 12	9 (39.1)
WBC, $\times 10^9$ /L	23	8.7 $\pm$ 4.1	7.9 (0.7–19.2)	> 11	7 (30.4)
LDH, U/L	23	374.7 $\pm$ 183.5	322 (181–836)	> 250	14 (60.9)
Sodium, mmol/L	27	139.4 $\pm$ 6.6	140 (120–149)	< 135	5 (18.5)
Potassium, mmol/L	27	4.01 $\pm$ 0.60	4.06 (3.0–5.1)	< 3.5	6 (22.2)
Calcium, mmol/L	25	2.22 $\pm$ 0.17	2.24 (1.9–2.6)	< 2.10	8 (32.0)
Glucose, mmol/L	13	6.9 $\pm$ 3.2	5.3 (4.4–13.4)	> 7.8	3 (23.1)
<i>Last measurement during admission</i>					
Albumin, g/L	16	35.5 $\pm$ 6.1	35.8 (25.5–44.3)	< 35	7 (43.8)
Haemoglobin, g/dL	19	12.9 $\pm$ 1.7	13.3 (8.7–15.7)	< 12	4 (21.1)
WBC, $\times 10^9$ /L	19	8.8 $\pm$ 4.2	8.5 (1.1–17.2)	> 11	5 (26.3)
LDH, U/L	13	368.8 $\pm$ 167.6	330 (119–623)	> 250	10 (76.9)
Sodium, mmol/L	19	140.1 $\pm$ 6.6	140 (131–159)	< 135	3 (15.8)
Laboratory values obtained in the referring unit before transfer were available in fewer than one third of patients and were not analysed. C-reactive protein was not recorded consistently and was not analysed.					
LDH lactate dehydrogenase; SD standard deviation; WBC white blood cell count.					

Parameter	n	Mean $\pm$ SD	Median (range)	Threshold	Abnormal, n (%)
Potassium, mmol/L	19	4.19 $\pm$ 0.62	4.30 (3.1–5.3)	< 3.5	3 (15.8)
Calcium, mmol/L	16	2.20 $\pm$ 0.17	2.25 (1.8–2.5)	< 2.10	3 (18.8)
Glucose, mmol/L	5	5.4 $\pm$ 1.4	5.9 (3.5–6.8)	> 7.8	0 (0.0)
Laboratory values obtained in the referring unit before transfer were available in fewer than one third of patients and were not analysed. C-reactive protein was not recorded consistently and was not analysed.					
LDH lactate dehydrogenase; SD standard deviation; WBC white blood cell count.					

Medication trajectory

Medication use changed markedly between the pre-admission and in-hospital periods (Fig. 3, Table 2). Before admission, 27 patients (87.1%) were receiving corticosteroids and 20 (64.5%) antiepileptic drugs, whereas only six (19.4%) were receiving opioids and one (3.2%) a benzodiazepine. During the admission, corticosteroid use fell to 19 patients (61.3%) and antiepileptic use to 13 (41.9%), while opioid use rose to 13 patients (41.9%), benzodiazepine use to eight (25.8%) and non-steroidal anti-inflammatory use from five (16.1%) to 14 (45.2%). Supportive interventions during the admission included oxygen in 13 patients (41.9%), intravenous fluids in 13 (41.9%), mannitol in 11 (35.5%) and urinary catheterisation in eight (25.8%).

Survival and circumstances of death

Twenty-one patients (67.7%) died during the index admission and 10 (32.3%) were discharged alive, seven of them home. Median time from admission to in-hospital death was 28 days (Fig. 2). The estimated probability of remaining alive in hospital was 77.0% (95% CI 62.0–92.0) at 7 days, 62.8% (95% CI 45.3–80.4) at 14 days and 45.3% (95% CI 25.8–64.8) at 30 days. Among the 21 patients who died, survival after admission had a median of 11 days (IQR 5–40, range 0–96); seven (33.3%) died within 7 days and 11 (52.4%) within 14 days of admission. Death followed a gradual cessation of vital functions in 20 of 21 patients (95.2%) and sudden cardiorespiratory failure in one (4.8%). Family members were present at the moment of death in four cases (19.0%).

DISCUSSION

In this cohort of 31 adults with high-grade glioma admitted during their terminal illness, three findings stand out. First, the admission was almost always unplanned: 94% arrived acutely from an emergency department or another ward and only 6% from hospice, despite a functional status – ECOG 3–4 and KPS $\leq$ 50% in 84% – that had plainly been deteriorating for some time. Second, the medication profile inverted across the hospital door: corticosteroids and antiepileptics, the drugs of tumour-directed

supportive care, were being taken by the great majority before admission and were reduced during it, while opioids and benzodiazepines, the drugs of comfort-focused care, rose two- to eightfold. Third, death came quickly — a third of those who died did so within a week — and in four fifths of cases without family at the bedside. Together these observations describe a transition to comfort-focused care that occurred not in the community over weeks, as guidance recommends, but inside an acute hospital over days.

Symptom burden and the problem of assessment

The symptom profile is consistent with the established picture of the terminal phase in high-grade glioma. Limb weakness, seizures, impaired consciousness and speech impairment led, and somatic symptoms were comparatively infrequent — the pattern first described by Sizoo and colleagues and confirmed prospectively since [6, 7, 8, 12]. For supportive care services this profile creates a specific difficulty. More than three quarters of our patients had impaired consciousness, dysphasia or disorientation on arrival, so the self-report instruments on which routine symptom assessment depends were unusable in the majority from the outset. The 35% of patients with documented restlessness or non-verbal signs of distress during the admission are the visible portion of a symptom burden that could only be inferred. Services caring for these patients need observational assessment as the default rather than the fallback, and proxy and staff-observed measures should be embedded before capacity is lost rather than improvised afterwards.

The frequency of seizures at admission (45%) sits within the 30–60% range reported for the end-of-life phase [18, 19]. The apparent fall during the admission (6.5%) should not be read as improved control so much as reduced detection: as consciousness declines, seizure activity becomes harder to recognise. This is precisely the setting in which systematic reviews recommend anticipatory conversion to a non-oral antiepileptic [18, 19]. That antiepileptic use fell from 65% to 42% in patients who were largely losing the oral route suggests such conversion did not reliably occur.

The medication trajectory as a marker of a late transition

The medication inversion deserves emphasis because it is measurable, actionable and, to our knowledge, not previously quantified at the level of individual prescriptions in this population. The reduction in corticosteroid exposure during the admission is clinically appropriate: long-term dexamethasone offers little benefit once tumour-directed treatment has ceased and carries substantial harm [20, 21]. The problem is the timing. That 87% of patients were still on corticosteroids at the point of terminal admission while fewer than one in five was receiving an opioid indicates that the shift in goals of care had not taken place in the community. The hospital then performed in days a transition that should have been made gradually beforehand.

Anticipatory prescribing exists precisely to prevent this. Providing injectable medication for anticipated symptoms in the community is established practice in several countries and is believed by clinicians to improve symptom control and to prevent crisis admissions, although the supporting evidence base

remains thin and patient and carer perspectives are under-studied [22, 23]. Our data do not test whether anticipatory prescribing would have prevented these admissions, but they identify the population in which it was not in place and describe the drugs that were ultimately needed – opioids, benzodiazepines and, by implication, a non-oral antiepileptic. That is a concrete specification for what an anticipatory kit for high-grade glioma should contain.

Comparison with end-of-life care quality indicators

Our findings invite comparison with the standard indicators of aggressive end-of-life cancer care, which set benchmarks of fewer than 17% of deaths in an acute-care institution and at least 55% of patients receiving hospice services before death [1]. That comparison must be made carefully. Our denominator is patients admitted to a hospital palliative medicine unit, not all patients dying of high-grade glioma, so the proportion dying in hospital is partly determined by the study design and cannot be read against the benchmark directly. What can be read is the route in: only two of 31 patients arrived from hospice, 44% of those with documented arrangements had no community support at all, and 94% arrived through an acute pathway. Whatever the correct population-level figure, the patients who reached this ward reached it in crisis. This is consistent with registry analyses reporting persistent emergency use and late hospice enrolment in neuro-oncology [13, 14, 16], and with evidence that prior palliative care contact reduces subsequent hospital resource use in brain tumour patients [15].

Family were present at only 19% of deaths. The evidence here is more nuanced than it first appears: in a large bereavement study, it was meaningful communication before death rather than physical presence at the moment of death that predicted later depression and complicated grief [24]. That nuance strengthens rather than weakens the argument. In high-grade glioma the capacity for that communication is lost early, so a transition left as late as the one we describe forecloses the conversation that matters most, and does so before the family is aware the opportunity is closing. Caregiver studies in glioma consistently report relatives feeling unprepared for the terminal phase and its neurological features [25, 26, 27, 28], and early advance care planning has been associated with less aggressive end-of-life care in glioblastoma [29, 30].

Laboratory markers

Laboratory abnormalities were present but, apart from LDH, mild, and we caution against over-interpreting them. Mean albumin and haemoglobin remained close to the reference range even at the last measurement, and fewer than half the patients had frank hypoalbuminaemia or anaemia. Systemic markers of dying that perform reasonably in advanced systemic cancer [31, 32] appear less discriminating here, which is what the biology would predict: the terminal trajectory in high-grade glioma is driven by intracranial progression rather than by cachexia and systemic inflammation. Functional and neurological measures are likely to remain the more useful bedside prognostic tools [33, 34, 35], and our data support using performance status rather than laboratory panels to recognise the terminal phase in this population.

Implications for practice

Three implications follow. First, referral to specialist palliative care should be triggered by functional decline rather than by crisis presentation; a KPS falling to 50% or below in a patient with recurrent high-grade glioma is a reasonable and easily applied prompt. Early specialist palliative involvement improves quality of life and reduces aggressive treatment near death in advanced cancer generally [36, 37], and there is no reason to expect high-grade glioma to be an exception. Second, anticipatory prescribing for this population should be specified in neurological terms, with a non-oral antiepileptic alongside the usual opioid and sedative, and should be in place before the oral route is lost. Third, because decision-making capacity is lost early and often, advance care planning and the conversations families later depend on must be initiated while the patient can still take part.

Strengths and limitations

The strengths of this study are the detailed clinical phenotyping of an admission that is seldom characterised, and the integration of symptom, functional, laboratory, pharmacological and survival data on the same patients. The limitations are substantial. The design is retrospective and single-centre, and the cohort is small, which precludes multivariable analysis and makes the confidence intervals around the survival estimates wide. Symptoms were recorded by the treating team without a structured instrument, so the data reflect documentation as much as symptom prevalence; the apparent decline in seizure frequency during the admission is likely to be an example. Medication was captured at class level only, without dose or route, so we cannot show whether antiepileptics were converted to a non-oral formulation or simply stopped – a limitation that bears directly on our own argument. Molecular characterisation was incomplete in patients diagnosed before the 2021 WHO classification, and we therefore analysed grade 3 and grade 4 tumours together, introducing biological heterogeneity. Laboratory data were incomplete for several parameters and C-reactive protein was unavailable. Finally, patients admitted to a specialised palliative medicine department may not represent all patients with high-grade glioma who die in hospital.

CONCLUSION

Adults with high-grade glioma admitted during their terminal illness present with severe neurological impairment, near-total functional dependency, symptom burden that is largely not self-reportable, and short survival. Their care is reorganised abruptly at the point of admission, with tumour-directed supportive medication withdrawn and comfort-focused medication introduced within days of death. The terminal admission in this population functions as a late substitute for a transition that should have taken place earlier and in the community. Triggering palliative referral on functional decline, prescribing anticipatorily in neurologically specific terms, and beginning advance care planning while capacity remains are the most tractable targets for improving supportive care at the end of life in high-grade glioma.

Declarations

Competing interests

The authors have no relevant financial or non-financial interests to disclose.

Ethics approval

This study was approved by the Bioethics Committee of Jagiellonian University Medical College. All procedures were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

Consent to participate

The retrospective design and the use of anonymised data qualified the study for a waiver of informed consent, granted by the Bioethics Committee.

Consent to publish

Not applicable; the manuscript contains no individually identifying information.

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No funding was received for conducting this study.

Author Contribution

RMK: conceptualization, methodology, formal analysis, writing – original draft. GAB and IK: data curation, investigation. SAP: data curation, writing – review and editing. KS and BMK: supervision, writing – review and editing. MK: investigation, resources. IFB: conceptualization, supervision, writing – review and editing. All authors read and approved the final manuscript.

Data availability

The anonymised dataset analysed during the current study is available from the corresponding author on reasonable request.

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Figures

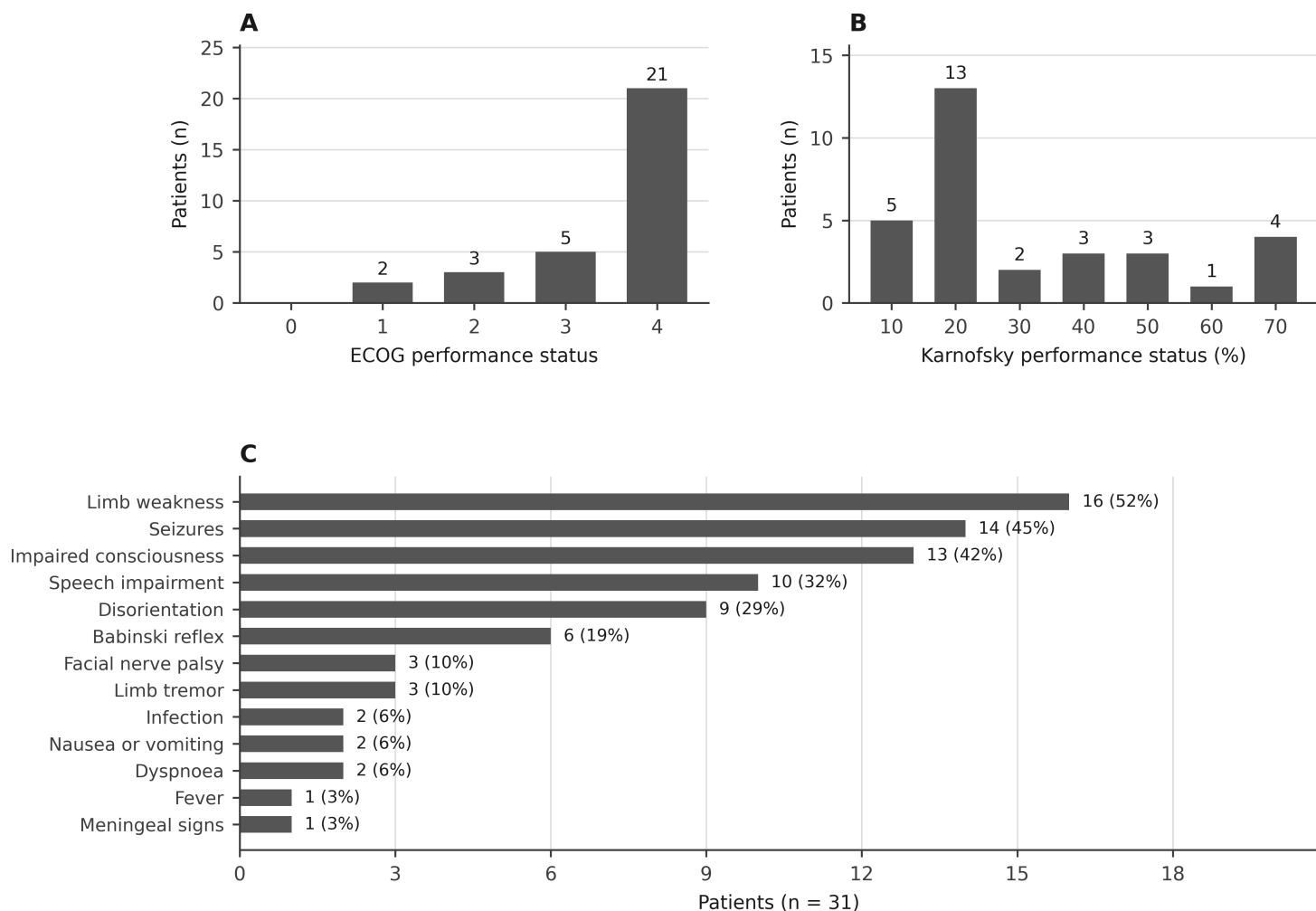
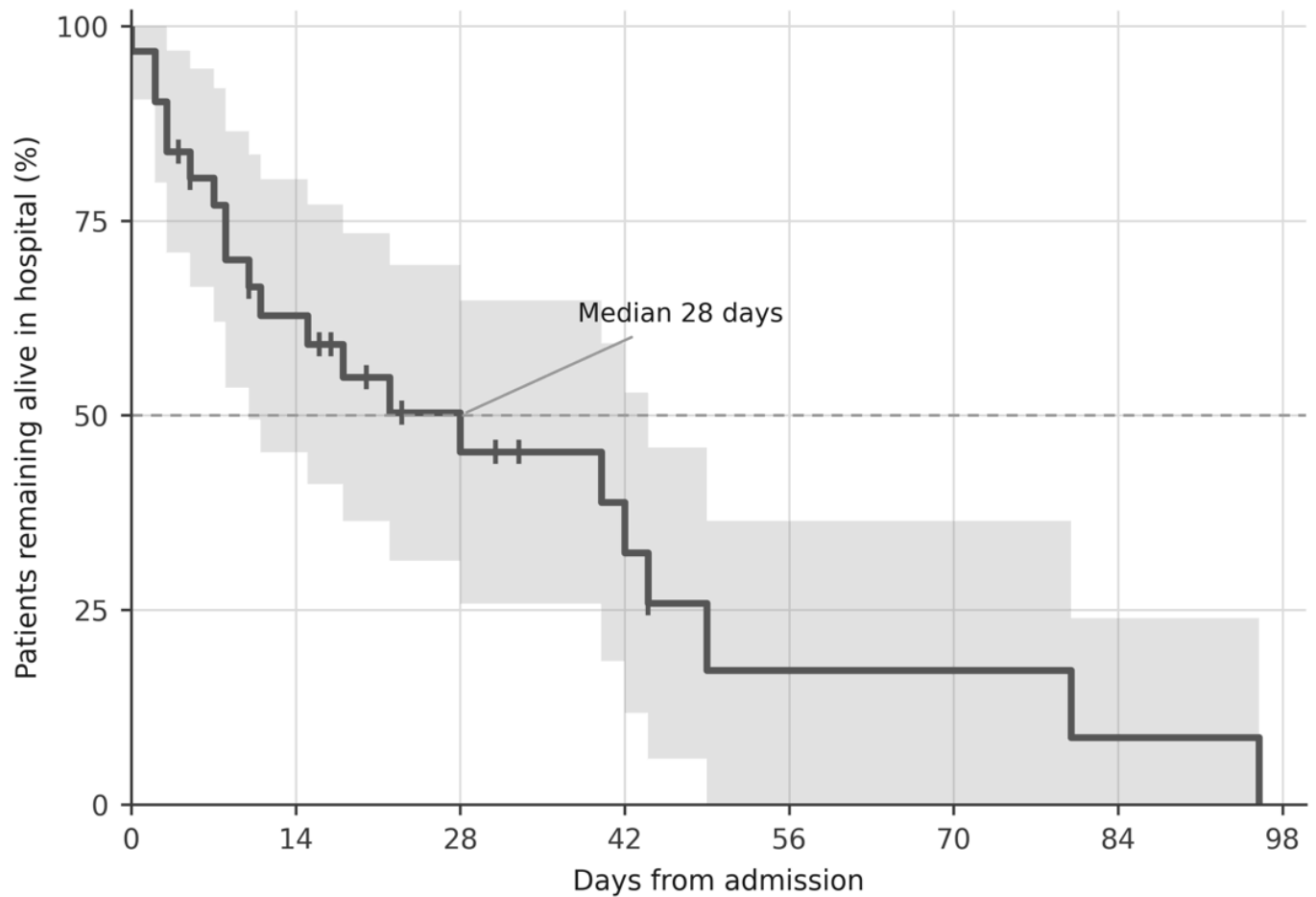


Figure 1

Functional status and symptom burden at admission (n = 31). (A) Eastern Cooperative Oncology Group (ECOG) performance status. (B) Karnofsky Performance Status. (C) Frequency of neurological and systemic symptoms documented at admission, ordered by frequency.



At risk	31	17	10	6	2	2	1	0
Deaths	1	11	15	17	19	19	20	21

Figure 2

Kaplan–Meier estimate of time from admission to in-hospital death ($n = 31$, 21 events). Patients discharged alive were censored at discharge (vertical ticks). The shaded band is the 95% confidence interval (Greenwood). Numbers at risk and cumulative deaths are shown below the x-axis.

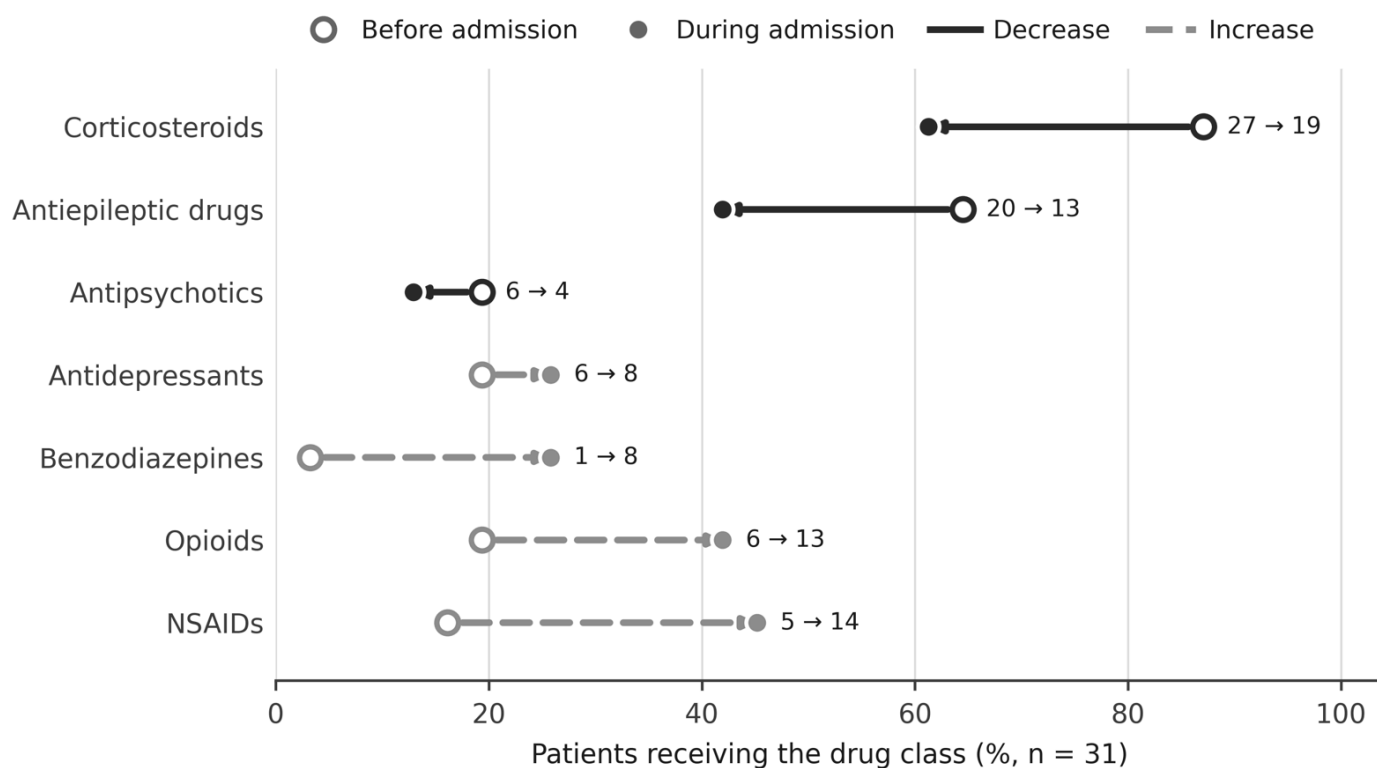


Figure 3

Change in medication use between the pre-admission and in-hospital periods (n = 31). Open circles denote the proportion receiving each drug class before admission, filled circles the proportion during the admission; classes are ordered by the size and direction of change. Counts of patients are shown at the right of each row.