Neurocognitive Dysfunction in Newly Diagnosed High-Grade Glioma Patients: Utilization of Standardized Computerized Neurocognitive Testing

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BACKGROUND AND RATIONALE

- Diagnosis with and treatment of high-grade gliomas (HGGs) can lead to neurological dysfunction, primarily neurocognitive dysfunction.
- Testing for neurocognitive dysfunction is usually performed using an extensive neuropsychological testing.
- Computerized neurocognitive testing is being used to a greater degree in this population and other groups.

OBJECTIVE

- To understand and evaluate the neurocognition of newly diagnosed HGG patients after surgery utilizing a computerized testing.

ELIGIBILITY

Inclusion

- Pathologically confirmed diagnosis of HGG (WHO grade III or WHO grade IV)
- Age greater than or equal to 18 at time of diagnosis
- Patients had to be able to read and write English
- Patients had to be able to use the computer and complete the computerized testing
- Karfosky performance status >/= 70
- Signed written informed consent

NEUROCOGNITIVE TESTING

- Neurocognitive testing was performed with computerized program CNS Vital Signs® and included domains of cognitive flexibility, complex attention, executive functioning, psychomotor speed, processing speed, verbal and visual memory
- Standard scores are normalized from raw scores and present an age-matched score relative to other people in a normative sample. For this analysis, standardized scores less than 20 were truncated at 20.

Domain	Tests
Cognitive Flexibility	Shifting Attention Task Stroop Test
Complex Attention	Shifting Attention Task Stroop Test Continuous Performance
Executive Functioning	Shifting Attention Task
Psychomotor Speed	Symbol Digit Coding Finger Tapping Task
Processing Speed	Symbol Digit Coding
Verbal Memory	Verbal Memory
Visual Memory	Visual Memory

ANALYSIS

- 116 patients were enrolled from September 2010 to May 2013 for neurocognitive testing.
- 102 (88%) subjects completed full neurocognitive battery.
- Descriptive statistics were performed along with regression analyses of factors predictive of NC function.
- Mean standardized score for normative age-matched subjects for all domains is 100 with lower scores identifying poorer NC performance with scores <20 truncated.

PATIENT DEMOGRAPHICS

Table 1: Patient Demographics

Patient Characteristic	
All, N (%)	102 (100)
Gender, N (%)	
Female	62 (39.2)
Male	40 (60.8)
Tumor Grade, N (%)	
WHO grade III	7 (6.9)
WHO grade IV	95 (93.1)
Surgery, N (%)	
Gross Total Resection	64 (62.7)
Subtotal Resection	16 (15.7)
Biopsy	22 (21.6)
Tumor Hemisphere, N (%)	
Right	45 (44.1)
Left	51 (50)
Bilateral	6 (5.9)
Lobe Location, N (%)	
Frontal	38 (37.2)
Temporal	25 (24.5)
Parietal	29 (28.3)
Occipital	5 (4.9)
Posterior Fossa	1 (1)
Multifocal	4 (3.9)
KPS at Testing, N (%)	
100	6 (6.2)
90	46 (47)
<90	45 (46)
Age, mean (sd)	56.0 years (12.5 years)
Education, mean (sd)	15.1 years (2.6 years)
Use of Antiepileptic, N (%)	
No	27 (26.5)
Yes	75 (73.5)
Use of Corticosteroid	
No	32(31.4)
Yes	70 (68.6)

RESULTS

Table 2: Neurocognitive Performance After Surgery in HGG

Study Measure	N	Mean	SD	Median	Min	Max
Cognitive Flexibility	102	72.7	31.2	81	20	121
Complex Attention	102	74.0	35.0	86	20	118
Executive Functioning	102	73.6	30.3	83	20	120
Processing Speed	102	80.5	22.1	83.5	20	121
Psychomotor Speed	102	82.2	22.3	87	20	117
Verbal Memory	102	83.8	23.2	84	20	124
Visual Memory	102	90.1	19.7	93	34	128

Table 3: Predictors of Neurocognitive Performance in HGG (Executive Functioning and Processing Speed)

	Variable	Estimate	SE	P Value
Executive Functioning				
	Surgery Extent	-9.00	2.5	0.012
	KPS	1.22	0.37	0.002
	Age	-0.3	.23	0.2
	Education	1.85	1.13	0.106
	Grade	8.1	11.9	0.5
	Tumor Location	-0.56	2.4	0.82
Processing Speed				
	Surgery Extent	-6.5	2.5	0.014
	KPS	1.01	.27	0.000
	Age	-0.26	.17	0.137
	Education	1.5	.82	0.062
	Grade	-5.3	8.6	0.546
	Tumor Location	-2.3	1.76	0.192

CONCLUSIONS

- After surgical, neurocognitive dysfunction is measurable in HGG patients and a computerized battery can be used for documentation.
- Most affected modalities are cognitive flexibility, complex attention, and executive functioning.
- In our population, KPS and extent of surgery were significant predictors of neurocognitive performance after surgery in newly diagnosed HGGs.

ABSTRACT

High-grade gliomas (HGGs) are associated with a poor MOS of 1-3 yrs. Patients not only contend with oncologic diagnosis but also a neurologic one that can lead to neurocognitive (NC) dysfunction. To understand the NC burden that HGG patients experience, we evaluated NC functioning in 116 newly -diagnosed consented HGG patients using a computerized battery. Clinical and demographic information was obtained. NC testing was performed with computerized program CNS Vital Signs® including domains of cognitive flexibility, complex attention, executive functioning, psychomotor speed, processing speed, verbal and visual memory. Descriptive statistics were performed along with regression analyses of factors predictive of NC function. Mean standardized score for normative age-matched subjects for all domains is 100 with lower scores identifying poorer NC performance with scores <20 truncated. 102 (88%) subjects completed NC testing. Mean age was 56.0 yrs (sd=12.5) and mean education was 15.1 yrs (sd=2.6). At testing, majority had KPS ≥ 80 (90.7%). Despite high performance status and high educational level, the mean standardized scores were below 100 [cognitive flexibility=72.7 (sd=31.2), complex attention=74.0 (sd=35.0) executive functioning =73.6 (sd=30.3), processing speed=80.5 (sd=22.1), psychomotor speed=82.2 (sd=22.3), verbal memory=83.8 (sd=23.2), and visual memory=90.1 (sd=19.7)]. KPS predicted performance on memory domains (p=0.009), psychomotor speed (p=0.0), complex attention (p=0.0003), cognitive flexibility (p=0.001), processing speed (p=0.0003) and executive functioning (p=0.002). Surgery extent was significantly associated with NC domains, except verbal memory, such that GTR performed better on NC testing than patients with STR or biopsy. Performance on most NC domains was independent of age and education, except age was predictive of visual memory (p=0.03) and education was predictive of verbal memory (p=0.02). Performance was independent of gender, grade, and tumor location. HGG patients experience NC dysfunction after surgery and NC can be measured using a computerized battery. KPS and surgery extent are important predictors of NC performance.

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