Incidence of Emergence Delirium in Glioblastoma Patients Undergoing Awake Craniotomy: A Retrospective Single Institutional Experience

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Introduction

Despite recent advances in the use of functional magnetic resonance imaging (fMRI) and tractography during preoperative planning, awake craniotomy remains the technique of choice when manipulating lesions involving eloquent cortex. Its ability to provide real time feedback makes it the most reliable method to ensure neurological integrity during resection of highly infiltrating tumors like glioblastoma. A potential complication of this approach is emergence delirium during the awake portion, which if not resolved may lead to suboptimal resection. Risk factors for delirium during awake craniotomy remain unknown.

Table 1: Baseline characteristics of patients undergoing awake craniotomy

	All Patients (n=116)	Agitated (n=8)	Non-Agitated (n=108)	*p-value
Age, mean ± SD (years)	49.39 ± 15.21	53.00 ± 12.87	49.12 ± 15.39	0.4869
Female, n (%)	52 (44.83)	2 (25.00)	50 (46.30)	0.2936
Male, n (%)	64 (55.17)	6 (75.00)	58 (53.70)	0.2936
Height, mean ± SD (m)	1.73 ± 0.10	1.78 ± 0.10	1.73 ± 0.10	0.1601
Weight, mean ± SD (kg)	79.23 ± 16.56	102.21 ± 15.56	77.53 ± 15.38	0.0009*
BMI, mean ± SD (kg/m^2)	26.56 ± 5.14	32.21 ± 4.86	26.15 ± 4.93	0.0057*
Smoker (%)	28 (24.14)	1 (12.50)	27 (25.00)	0.6776
Anxiety, n (%)	23 (19.83)	1 (12.50)	22 (20.37)	1.000
Asthma, n (%)	11 (9.49)	2 (25.00)	9 (8.33)	0.1670
GERD, n (%)	22 (18.97)	1 (12.50)	21 (19.44)	1.000
Hyperlipidemia, n (%)	21 (18.10)	3 (37.50)	18 (16.67)	0.1561
HTN (%)	33 (28.45)	5 (62.50)	28 (25.93)	0.0408*
OSA, n (%)	5 (4.31)	1 (12.50)	4 (3.70)	0.3050
Seizures, n (%)	49 (42.24)	2 (25.00)	47 (43.52)	0.4643

P-values obtained using ordinal logistic regression or Fisher's exact test. BMI – Body mass index; GERD – Gastroesophageal reflux disease; HTN – Hypertension; OSA – Obstructive sleep apnea

Table 2: Pre-existing classes of medications for patients undergoing awake craniotomy

	All Patients (n=116)	Agitated (n=8)	Non-Agitated (n=108)	*p-value
ACE inhibitor	15 (12.93)	2 (25.00)	13 (12.04)	0.2758
Alpha-blocker	7 (6.03)	1 (12.50)	6 (5.56)	0.4020
Anticholinergic	6 (5.17)	0 (0.00)	6 (5.56)	1.000
Anticonvulsant	76 (65.52)	3 (37.50)	73 (67.59)	0.1221
Antihistamine	13 (11.21)	1 (12.50)	12 (11.11)	1.000
Barbituate	4 (3.45)	1 (12.50)	3 (2.78)	0.2515
Beta-blocker	10 (8.62)	1 (12.50)	9 (8.33)	0.5253
Benzodiazepine	25 (21.55)	2 (25.00)	23 (21.29)	0.6815
Bronchodilator	9 (7.76)	1 (12.50)	8 (7.41)	0.4869
Ca^{2+} channel blocker	9 (7.76)	2 (25.00)	7 (6.48)	0.1175
Diuretic	14 (12.07)	2 (25.00)	12 (11.11)	0.2479
H2 blocker	20 (17.24)	2 (25.00)	18 (16.67)	0.6248
NSAID	8 (6.89)	3 (37.50)	5 (4.63)	0.0550
Opiate	6 (5.17)	0 (0.00)	6 (5.55)	1.000
PPI	19 (16.38)	2 (25.00)	17 (15.74)	0.6158
Sleep aid	9 (7.76)	2 (25.00)	7 (6.48)	0.1175
SSRI	14 (12.96)	0 (0.00)	14 (12.96)	0.5930
Statin	18 (15.52)	4 (50.00)	14 (12.96)	0.0196*
Steroid	59 (50.86)	3 (37.50)	56 (51.85)	0.4864
Thyroid hormone	10 (8.69)	1 (12.50)	9 (8.41)	0.5286

All values expressed as n (%). P-values obtained using Fisher's exact test.

Methods

We retrospectively reviewed 116 instances of awake craniotomy for glioblastoma resection at Duke University Medical Center between January 2009 and March 2010. Patients were categorized as either agitated or non-agitated based on intra-operative reports; ambiguous terminology such as 'uncooperative' warranted exclusion from the agitated cohort. Resulting cohorts were analyzed for predictors of emergence delirium according to age, gender, weight, height, BMI, past medical and medication history. Data was analyzed using ordinal logistic regression and the Fisher's exact test.

Results

Of 116 patients who underwent awake craniotomy, 8 experienced emergence delirium. This translated into an incidence of 7% (CI, 3.5 – 13.0%). Comparison between the two cohorts revealed pre-existing hypertension (62.50 vs. 25.93%, p=0.0408), elevated BMI (32.21±4.86 vs. 26.15±4.93 kg/m2, p=0.0057) and increased weight (102.21±15.56 vs. 77.53±15.38 kg, p=0.0009) to all be predisposing factors for emergence delirium (Table 1). Statins were more frequently prescribed (50.00 vs. 12.96%, p=0.0196) to patients developing emergence delirium (Table 2).

Conclusions

The incidence of emergence delirium during awake craniotomy at DUMC is 7%, which is likely to be an underestimation. Conditions predisposing to emergence delirium during awake craniotomy included pre-existing hypertension, high BMI, and increased weight. Drug regimens of patients developing delirium more frequently included statins. Hopefully, identification of risk factors for emergence delirium during awake craniotomy can improve preoperative management and postsurgical outcomes for glioblastoma patients.