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Early unplanned reoperations in supratentorial brain tumors

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ABSTRACT

Background: Surgical treatment of brain tumors were proved to be at highest risk of unplanned reoperation. Therefore, we decided to find possible predictors of complications leading to early unplanned reoperations among patients with supratentorial brain tumors.

Methods: We retrospectively analysed 328 patients who underwent craniotomy due to supratentorial brain tumor. Early reoperation was defined as reoperation during the same hospital stay. To determine the potential predictors of early reoperation we used univariate and multivariate logistic regression analyses.

Results: A total of 22 (6.51%) patients underwent unplanned reoperation. Those patients significantly more often were diagnosed with high grade glioma (81.82% vs. 55.70%; $p = 0.02$). They had lower Red Blood Cells count (4.16 ± 0.82 vs. 4.60 ± 0.56 10^3/μl; $p < 0.01$) and haemoglobin (12.58 ± 2.46 vs. 13.7 ± 1.72 g/dl; $p < 0.01$) and lower haematocrit (36.93 ± 6.84 vs. 39.94 ± 4.66%; $p < 0.01$) preceding surgery. Surgeries of reoperated patients more often were performed during "on call" hours (17.65% vs. 4.49%; $p = 0.02$). After adjustment for possible confounders frontal craniotomy (OR: 2.961; 95% CI: 1.042–8.406; $p = 0.04$)and "on call" hours of surgery (OR: 2.961; 1.042–8.406; $p = 0.04$) remained independently associated with higher risk of reoperation.

Conclusions: Frontal craniotomy and surgery during "on call" hours are independently associated with higher risk of reoperation in supratentorial brain tumors.

1. Introduction

Unplanned reoperations constitute a significant part of complications in all of surgical specialties [1–4]. They are considered as important quality indicator and can be associated with significant economic burden [5]. In terms of neurosurgery, among all possible causes of operation brain tumors were proved to be at highest risk of unplanned reoperation both in children and adults [6–8]. Postoperative complications were shown to be associated with higher mortality [9,10] and postoperative haemorrhage established as most frequent cause of death [11]. Unplanned reoperation is also linked with prolonged hospitalization [9]. Reoperation rate among patients with brain tumors varies between 2 and 11% and most commonly indicated risk factors are clotting disorders, older age and infratentorial location [9,10,12]. However, there are still many inaccuracies in terms of other predictors especially that, due to our knowledge, there are limited studies analysing only intrinsic supratentorial tumors. Therefore, we decided to find possible predictors of complications leading to early unplanned reoperations among patients with supratentorial brain tumors. We also aimed at establishing rate of early unplanned reoperations for those patients.

2. Methods and materials

We retrospectively analysed 328 patients who underwent craniotomy due to supratentorial brain tumor operated in department of neurosurgery between January of 2015 and December of 2016. From their medical record we obtained detailed medical history which included chronic diseases and current medications. We also obtained blood test results taken within 24 h before surgery together with details concerning operation such as its date, duration, cause, type and side of craniotomy and whether doctor who performed surgery and their assistant were specialist in neurosurgery or neurosurgeon in training. Additionally, we obtained details about tumors such as its location, histological type and whether complete removal was achieved. Early unplanned reoperation was defined as reoperation that occurred during the same hospitalization. Study protocol was approved by local bioethical committee.

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Table 1
Detailed characteristics of patients that underwent reoperation and control group.

	Reoperation (n = 22)	No reoperation (n = 306)	p-value
Age [years] ± SD	60.18 ± 11.89	58.51 ± 13.88	0.58
Female gender [%]	50.00 (11)	48.42 (153)	0.89
Medical history			
Hypertension [%]	36.36 (8)	33.54 (106)	0.79
Diabetes mellitus [%]	9.09 (2)	15.19 (48)	0.44
Cigarette smoking [%]	18.18 (4)	19.62 (62)	0.87
Alcohol abuse [%]	4.55 (1)	9.18 (29)	0.46
Ischemic heart disease [%]	9.09 (2)	2.85 (9)	0.11
History of heart attack [%]	0 (0)	2.22 (7)	0.48
History of ischemic stroke [%]	0 (0)	4.11 (13)	0.33
Atrial fibrillation [%]	0 (0)	1.58 (5)	0.55
Lungs diseases [%]	0 (0)	0.95 (3)	0.65
Hyperthyroidism [%]	0 (0)	0.95 (3)	0.65
Hypothyroidism [%]	0 (0)	2.22 (7)	0.48
Hypercholesterolemia [%]	9.09 (2)	1.90 (6)	0.03
Current medications			
Acetylsalicylic acid [%]	0 (0)	3.48 (11)	0.37
Beta-blockers [%]	4.55 (1)	9.49 (30)	0.44
Angiotensin-converting-enzyme inhibitors [%]	18.18 (4)	12.97 (41)	0.49
AT_2-blockers [%]	0 (0)	0.63 (2)	0.71
Calcium channel blockers [%]	0 (0)	6.33 (20)	0.22
Diuretics [%]	9.09 (2)	13.92 (44)	0.52
Steroids [%]	9.09 (2)	15.19 (48)	0.44
Antidiabetic therapy [%]	0 (0)	5.06 (16)	0.28
Insulin [%]	0 (0)	2.22 (7)	0.48
Heparin [%]	0 (0)	4.75 (15)	0.30
Anticoagulants [%]	0 (0)	2.85 (9)	0.42
Nitrates [%]	0 (0)	0.32 (1)	0.79
Statins [%]	0 (0)	1.27 (4)	0.60
Blood test results preceding surgery			
Red Blood Cells count [10^3/μl] ± SD	4.16 ± 0.82	4.6 ± 0.56	< 0.01
White Blood Cells count [10^3/μl] ± SD	10.00 ± 6.48	10.85 ± 5.07	0.46
Platelets count [10^3/μl] ± SD	219.64 ± 62.24	243.65 ± 74	0.14
Haemoglobin [g/dl]	12.58 ± 2.46	13.7 ± 1.72	< 0.01
Activated Partial Prothrombin Time [s] ± SD	27.52 ± 3.4	26.74 ± 3.91	0.39
International Normalized Ratio ± SD	1.02 ± 0.08	1 ± 0.08	0.25
Creatinine [μmol/l] ± SD	64.48 ± 24.52	71.71 ± 16.85	0.07
Glucose [mmol/l] ± SD	6.98 ± 2.41	6.2 ± 2.05	0.10
Mean Corpuscular Volume [μm^3] ± SD	89.11 ± 3.46	87.08 ± 4.71	0.05
Mean Corpuscular Haemoglobin [pg] ± SD	30.3 ± 1.48	29.85 ± 1.83	0.26
Mean Corpuscular Haemoglobin Concentration [g/dl] ± SD	34.02 ± 1.05	34.27 ± 1.12	0.30
Urea [mmol/l] ± SD	6.69 ± 2.74	6.92 ± 2.94	0.73
Sodium [mmol/l] ± SD	139.82 ± 4.49	139.12 ± 3.61	0.39
Potassium [mmol/l] ± SD	4.16 ± 0.5	4.35 ± 0.43	0.06
Prothrombin Time [s] ± SD	11.74 ± 0.95	11.55 ± 0.82	0.36
Haematocrit [%] ± SD	36.93 ± 6.84	39.94 ± 4.66	< 0.01

2.1. Statistical analysis

To perform statistical analysis we used $\chi 2$ test for proportional values and *t*-Student test and Mann-Whitney *U* test as appropriate for continuous variables. To determine the potential predictors of re-operation after supratentorial brain tumor removal we used univariate and multivariate logistic regression analysis. P-values < 0.05 were considered to be statistically significant. Threshold of p-value < 0.1 was used to qualify date to multivariate logistic regression analysis. Forward logistic regression analysis was followed by backwards logistic regression analysis. To perform all statistical analysis we used STATISTICA v. 10 for Windows (Statsoft, Poland).

3. Results

3.1. Study group characteristics

Our study group consisted of 328 patients and 164 of them (46.19%) of them were females. Mean age of study group was 58.61 ± 13.73 years. Details concerning demographic data and past medical history and current medications are presented in Table 1. The most common histological type of tumor was high grade glioma (57.39%), then metastatic tumor (26.33%) and low grade glioma (16.27%). Thirty-nine (11.54%) of tumors were recurrent. The most common tumor location was frontal lobe (41.48%), then temporal lobe (39.77%), occipital lobe (11.36%), intraventricular location (3.41%), insula (1.70%), parietal lobe (1.14%) and pineal gland (1.14%). One hundred twenty-five (36.98%) of tumors were in cortical location (Table 2).

3.2. Unplanned reoperations

A total of 22 (6.51%) patients underwent unplanned reoperation. Those patients significantly more often had hypercholesterolemia (9.09% vs. 1.90%; p = 0.03) and were diagnosed with high grade glioma (81.82% vs. 55.70%; p = 0.02). In preoperative blood test results they had lower Red Blood Cells (RBC) count (4.16 ± 0.82 vs. 4.60 ± 0.56 10^3/μl; $p < 0.01$) and haemoglobin (12.58 ± 2.46 vs. 13.7 ± 1.72 g/dl; $p < 0.01$), higher Mean Corpuscular Volume (89.11 ± 3.46 vs. 87.08 ± 4.71 μm^3; p = 0.05) and lower