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Neuroanatomical Studies

Safety of performing craniotomy in the elderly: The utility of co-morbidity indices☆

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ABSTRACT

Objectives: With the current trend of aging of the population, neurosurgeons will be more and more confronted to surgical decision-making involving the elderly. Faced with this increasing demand and frailty of aged patients, a better understanding on the post-operative outcome of this growing population is warranted. The objective of the present study is to assess the post-operative outcome in regard of complications of elderly patients undergoing a craniotomy.

Patients and methods: The files of consecutive patients aged 80 years old and more who underwent a craniotomy at a single institution were retrospectively reviewed. Data on demographics, surgical indication, length of surgery, operative blood loss, urgency of surgery, comorbidities using the Elixhauser comorbidity index and post-operative complications were gathered. We performed a multivariate analysis in search of risk factors for post-operative complications.

Results: A total of 53 patients were included in the study. The mean age of all patients was 84 years old with the main indication for surgery being subdural hematoma. The overall complication rate was 62%, with 34% of patients suffering from a major complication and 47% from a minor complication. The mean Elixhauser co-morbidity index, operative time and operative blood loss were similar to those reported in adult craniotomy series. None of the studied variables were statistically associated with the occurrence of complications in the multivariate analysis.

Conclusion: Patients 80 years-old and more were found to harbour a high complication rate following craniotomy when compared to literature. Our study suggests increasing age itself remains an important risk factor for postoperative complications.

1. Introduction

Craniotomy represents the standard mean of access to the encephalon. However, it can be associated with significant blood loss, local infection, extensive temporal muscle dissection, nerve injury and long operative time [1, 37]. The benefits to perform a craniotomy to access brain pathologies must be taken into account in the elderly, whose reserve for an invasive surgery is lower [14].

With the advancing age of the populations across the world [18], neurosurgeons will be more and more faced to perform such surgery in the elderly [3]. It is a well-known fact that perioperative mortality and morbidity for any surgery is higher in the elderly [4]. Nevertheless, few data exist regarding neurosurgical patients, with some studies showing that the aged population (65 to 75 years old and older) tolerate well craniotomy without elevated morbidity [6, 25, 34]. In this context, more knowledge is needed about the perioperative outcome of this growing population of patients. We report a series of patients aged 80 years old and older who were operated on via a craniotomy with a focus on post-operative complications and their determinants.

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2. Patients and methods

2.1. Patients and study design

This is a retrospective case series registered in a publicly accessible database (Research Registry). This study received approbation from our institution's ethic committee prior to data gathering. Patient consent was deemed not required due to the nature of the study (retrospective involving anonymized data). Inclusion criteria were as follow: patient aged > 80 years old at time of surgery, patient subjected to a craniotomy for any indication, surgery between May 2006 and March 2015. Exclusion criteria were as follow: surgery is a re-intervention during the same hospitalisation, uncertainty in the operative report that a craniotomy was performed, and surgery done in a traumatic setting.

2.2. Clinical data gathering

Data for each patient was gathered from medical files and operating protocols at a single institution. Extracted data for each patient included age, sex, surgical indication, comorbidities, urgency of surgery, operative blood loss, duration of surgery and the occurrence of post-operative complications of any kind during hospitalisation. Craniotomies were defined as interventions requiring the elevation of a cranial bone flap and opening of the dura. Standard peri-interventional care for these patients involved prophylactic antibiotics (cefazoline 1 g intravenously at induction then each 8 h for 3 doses), thromboprophylaxy (non-fractioned heparin 5000 units each 12 h starting 24 h after surgery) and a minimum of 12 h of post-operative surveillance in an intensive care unit.

Craniotomy surgeries were classified as either urgent or non-urgent. Urgent surgeries were defined according to the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) definition (http://www.ncepod.org.uk/classification.html): “Intervention for acute onset or clinical deterioration of potentially life-threatening conditions, for those conditions that may threaten the survival of limb or organ, for fixation of many fractures and for relief of pain or other distressing symptoms. Normally within hours of decision to operate”.

Patient's comorbidities were computed using the Elixhauser comorbidity classification [12], which classifies comorbidities into 30 groups and correlates with various outcomes such as in-hospital mortality [35] and healthcare expenditure [13]. The Elixhauser comorbidities groups for each patient were then used to calculate the Elixhauser index (or score) as described by van Walraven et al. [39] (Table 1). This score spans from −19 to +89, the higher values representing the group with the most severe comorbid status, and correlates directly with in-hospital probability of death [19, 23, 39].

Delirium, one of the researched post-operative complications, was counted only if diagnosed by an expert psychiatrist and was not present pre-operatively. Post-operative complications were further classified according to the Clavien-Dindo classification that grades post-operative complications on a scale from I to V according to severity [10] (Table 2). For this study, we group together grades I and II under “minor complications” while grades III to V are grouped together as “major complications”.

2.3. Statistical analysis

In search of risk factors for complications in the sample, we performed a univariate analysis using either a 2-tailed chisquare test or Fisher's exact test when applicable for dichotomic variables or a 2-tailed Student *t*-test for continuous variables. This univariate analysis was conducted to determine association between covariates (age, sex, surgical indication, Elixhauser comorbidity score, blood loss, urgency of surgery) and the following outcomes: occurrence of any complication, occurrence of minor complication and occurrence of major complication. For the analysis, surgical indications were classified according to

Table 1
Elixhauser Comorbidity groups with corresponding coding algorithm of the 10th revision of the International Statistical Classification of Diseases and points according to the van Walraven modification.

Elixhauser group	Corresponding ICD-10 coding algorithms for Elixhauser Comorbidities	Points
Congestive heart failure	I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, 142.5-I42.9, I43.x, I50.x, P29.0	7
Cardiac arrhythmia	I44.1-I44.3, I45.6, I45.9, I47.x-I49.x, ROO·O, ROO.1, ROO.8, T82.1, Z45.0, Z95.0	5
Valvular disease	A52.0, I05.x-I08.x, I09.1, I09.8, I34.x-I39.x, Q23.O-Q23.3, Z95.2, Z95.4	−1
Pulmonary circulation disorders	I26.x, I27.x, I28.0, I28.8, I28.9	4
Peripheral vascular disorders	I70.x, I71.x, I73.1, I73.8, I73.9, I77.1, I79.0, I79.2, K55.1, K55.8, K55.9, Z95.8, Z95.9	2
Hypertension	110.x, I11.x-I13.x, I15.x	0
Paralysis	G04.1, G11.4, G80.1, G80.2, G81.x, G82.x, G83.0-G83.4, G83.9	7
Neurodegenerative disorder	G10.x-G 13.x, G20.x-G22.x, G25.4, G25.5, G31.2, G31.8, G31.9, G32.x, G35.x-G37.x, G40.x, G41.x, G93.1, G93.4, R47.0, R56.x	6
Chronic pulmonary disease	I27.8, 127.9, J40.x-J47.x, J60.x-J67.x, J68.4, J70.1, J70.3	3
Diabetes, uncomplicated	E10.0, E10.1, E10.9, E11.0, E11.1, E11.9, E12.0, E12.1, E12.9, E13.0, E13.1, E13.9, E14.0, E14.1, E14.9	0
Diabetes, complicated	E10.2-E10.8, E11.2-E11.8, E12.2-E12.8, E13.2-E13.8, E14.2-E14.8	0
Hypothyroidism	E00.x-E03.x, E89.0	0
Renal failure	I12.0, I13.1, N18.x, NI9.x, N25.0, Z49.0-Z49.2, Z94.0, Z199.2	5
Liver disease	B18.x, I85.x, I86.4, I98.2, K70.x, K71.1, K71.3-K71.5, K71.7, K72.x-K74.x, K76.0, K76.2-K76.9. Z94.4	11
Peptic ulcer disease, no bleeding	K25.7, K25.9, K26.7, K26.9, K27.7, K27.9, K28.7, K28.9	0
AIDS/HIV	B20.x-B22.x, B24.x	0
Lymphoma	C81.x-C85.x, C88.x, C96.x, C90.0, C90.2	9
Metastatic cancer	C77.x-C80.x	12
Solid tumor, without metastasis	C00.x-C26.x, C30.x-C34.x, C37.x-C41.x, C43.x, C45.x-C58.x, C60.x-C76.x, C97.x	4
Rheumatoid arthritis/ collagen vascular disease	L94.0, L94.1, L94.3, M05.x, M06.x, M08.x, M12.0, M12.3, M30.x, M31.0-M31.3, M32.x-M35.x, M45.x, M46.1, M46.8, M46.9	0
Coagulopathy	D65-D68.x, D69.1, D69.3-D69.6	3
Obesity	E66.x	−4
Weight loss	E40.x-E46.x, R63.4, R64	6
Fluid and electrolyte disorders	E22.2, E86.x, E87.x	5
Blood loss anemia	D50.0	−2
Deficiency anemia	D50.8, D50.9, D51.x-D53.x	−2
Alcohol abuse	F10, E52, G62.1, I42.6, K29.2, K70.0, K70.3, K70.9, T51.x, Z50.2, Z71.4, Z72.1	0
Drug abuse	F11.x-F16.x, F18.x, F19.x, Z71.5. Z72.2	−7
Psychosis	F20.x, F22.x-F25.x, F28.x, F29.x, F30.2, F31.2, F31.5	0
Depression	F20.4, F31.3-F31.5, F32.x, F33.x, F34.1, F41.2, F43.2	−3

ICD-10: International Statistical Classification of Diseases, 10th revision.