



The incidence of postoperative thromboembolic complications following surgical resection of intracranial meningioma. A retrospective study of a large single center patient cohort

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ABSTRACT

Background: Patients with meningiomas carry an increased risk for postoperative venous thromboembolic complications (VTE) including deep venous thrombosis (DVT) and pulmonary embolism (PE).

Objective: In the present retrospective study we investigated the incidence of VTE and the risk factors involved, in a large cohort of patients surgically treated for an intracranial meningioma at our institution.

Methods: During the period from January 1997 to January 2009, 581 consecutive patients underwent craniotomy for intracranial meningioma. All patients received low-molecular weight heparins as thromboembolism prophylaxis. Patient demographics and tumor characteristics were gathered via retrospective chart review. Postoperative VTE and hemorrhages were noted. Backward stepwise logistic regression was used to determine the risk factors.

Results: 80.6% of meningiomas were WHO grade 1; 15.1% WHO grade 2; 4.3% WHO grade 3. Postoperative VTE were observed in 41 patients (7.2%). Of these, DVT was seen in 20 (3.5%) and PE in 26 patients (4.6%). The thromboembolic complication appeared on average 21.1 ± 29.2 days post surgery. The 90-day mortality rate after VTE was 11.2% (23.1% for PE and 5.0% for DVT). Postoperative hemorrhages requiring surgical treatment were found in 2.9% of patients. Risk factors for VTE were body mass index ($p = 0.015$) for DVT; weight ($p = 0.001$) and bedridden postoperatively ($p = 0.001$) for PE; and weight ($p = 0.004$) and bedridden postoperatively ($p = 0.003$) for VTE in general. There was no relation between tumor grade and thromboembolic complications.

Conclusion: The major risk factors for postoperative VTE found in our single center study are patient weight and a bedridden status postoperatively. Prophylactic intervention for this potentially fatal complication should be evaluated against the relative lower risk of postoperative hemorrhages.

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1. Introduction

Patients with intracranial meningioma who are surgically treated are at risk for developing postoperative venous thromboembolism (VTE), such as deep venous thrombosis (DVT) and pulmonary embolism (PE). The clinical incidence ranges up to 32% [1–9]. When using more sensitive methods, such as ¹²⁵I-fibrinogen-uptake tests, the incidence is reported to be as high as 72%

[10]. Both patient morbidity and mortality are greatly influenced by the occurrence of DVT and/or PE [2,11–14]. In view of the fact that meningioma is generally a benign tumor, it is especially provoking that any thromboembolic event can have fatal consequences.

Apart from the immobilization of the patients in the post-operative recovery period, tumor-induced hemostatic changes resulting in a hypercoagulable state may elicit VTE [10,15–18]. Other risk factors are patient age and weight, a history of thromboembolic events, extent of surgical blood loss, and presence of malignancy [9,10,16,19].

VTE may be treated either pharmacologically or by graduate compression stockings and the use of sequential compression devices in case of DVT [2,4,20,21]. Pharmacologic agents that have gained great importance in prophylaxis are low-molecular weight

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heparins, despite the potential risk of hemorrhage [5,6,15,21–27]. There remains, however, controversy about the prophylactic treatment of VTE with either or both pharmacologic and mechanic means in the treatment of neurosurgical patients with meningioma, despite an increasing body of confirmatory evidence [1,2,8,20,22,25,28,29]. To determine the number of and the risk factors for VTE in a large cohort of consecutive intracranial meningioma patients undergoing surgery, we performed a retrospective single-center analysis.

2. Patients and methods

A consecutive series of 581 patients who had undergone surgical treatment for an intracranial meningioma were retrospectively reviewed. These patients were treated in the period from January 1997 to January 2009. All patients were treated with low-molecular weight heparin starting 24 h after the completion of surgery. Per institutional guideline patients received 2850 AXa-IE (0.3 mL) Fraxodi® QD subcutaneously, or when belonging to a high-risk group for VTE 5700 aXa-IE (0.3 mL) Fraxodi® QD subcutaneously. During the study period no mechanical VTE (deep venous thrombosis (DVT) and pulmonary embolism (PE)) prophylaxis, such as compression stockings or intermittent pneumatic compression (IPC) was used.

Demographics, including patient age, sex, weight, length, body mass index, and the use of antithrombotic agents or anticoagulants, were extracted from patient charts. Furthermore, the location of the meningioma was noted and recorded as convexity, falx, sphenoid ridge (inner/middle/outer), or other. The other, less frequent, included suprasellar, tentorial, cerebellopontine angle, clivus, and posterior fossa convexity meningiomas. Operative reports were used to extract duration of surgery, i.e., from anesthesia induction until skin closure, blood loss, and preoperative embolisation. Postoperatively, the occurrence of VTE, histology, patient mobility, and hemorrhage requiring emergency surgery were recorded. In-hospital patient mobility was defined as the ambulatory status of a patient when discharged from hospital. The patients were scored either independent ambulatory, dependent ambulatory (indicating walking with a mobility aid, such as a cane or walker), wheel-chair bound, or bedridden. VTE-related mortality was defined as death within 90 days after the registered VTE.

2.1. Statistical analysis

All data were recorded into and analyzed with the commercially available statistical software package SPSS 15.0 for Windows (SPSS Inc., Chicago, Ill., USA). Continuous variables were univariately compared using a Student's *T*-test for parametric data and a Mann–Whitney *U*-test for non-parametric data and reported as mean values $\pm$ standard deviations (SD). Dichotomous and nominal variables were compared with chi-square and Fisher's exact test, and presented as percentages. *p*-values <0.05 were considered statistically significant. In order to analyze factors relating to the risk of postoperative VTE the variables were initially explored univariately as described above. Variables for which there was a high probability of association with the outcome ($p < 0.10$) were considered for the final multivariate regression model. Backward stepwise logistic regression was used for this purpose and odds ratios (OR) and 95% confidence intervals (95% CI) and *p*-values are presented, with postoperative VTE as outcome parameter.

3. Results

During the retrospective follow-up period of twelve years, 581 consecutive patients with intracranial meningiomas were

Table 1

Patient demographics and occurrence of postoperative thromboembolic complications.

Demographics	
Age (years)	56.2 $\pm$ 13.5
Sex (female: male)	401:180 (=2.2:1)
Weight (kg)	76.0 $\pm$ 14.4
Length (cm)	169 $\pm$ 8.5
Body mass index (kg m ⁻²)	26.5 $\pm$ 4.7
Pre-operative antithrombotic or anticoagulant therapy	61.5%
Thromboembolic complications	
Deep venous thrombosis (DVT)	3.5%
Pulmonary embolus (PE)	4.6%
DVT and/or PE	7.2%

Shown are mean values $\pm$ standard deviations (SD) for continuous variables and percentages for dichotomous variables.

surgically treated. Patient demographics are shown in Table 1. The patient's average age was 56.2 $\pm$ 13.5 years with a range of 16.6–89.3 years. The range in patient weight and body mass index was 42–142 kg and 16.1–47.3 kg m⁻², respectively. The female to male ratio was 2.2:1. A postoperative VTE in general was recorded in 41 (7.2%) patients after an average period of 21.1 $\pm$ 29.2 days (range 2–120 days). A DVT or PE alone occurred in 20 (3.5%) and 26 (4.6%) patients after an average of 25.9 $\pm$ 30.8 and 16.5 $\pm$ 25.5 days, respectively. Interestingly, only five patients were observed to have both a DVT as well as a PE. VTE-related mortality was 11.2% (7/41). 23.1% of patients with a PE and 5.0% of patients with DVT died within 90-days after the PE and DVT, respectively.

The meningiomas were most frequently located on the cerebral convexity (24.1%), sphenoid ridge (19.9%), and falx cerebri (19.8%). The remaining meningiomas, 36.2%, were located in the aforementioned regions. Pre-operatively, 17.1% of meningiomas were embolized as to the surgeon's preference. The total surgical time averaged 447 $\pm$ 181 min (range 143–1685 min), with an average blood loss of 1316 $\pm$ 1366 mL (range 100–11,000 mL). A postoperative hemorrhage needing emergency surgery occurred in 17 patients (2.9%). Only one of those patients was treated for a postoperative VTE. Histology revealed 80.6% benign (WHO I), 15.1% atypical (WHO II), and 4.3% malignant (WHO III) meningiomas. The postoperative in-hospital mobility status of all patients is shown in Table 2.

The univariate analysis of parameters that might relate to the occurrence of postoperative VTE is shown in Table 3. For DVT, only the body mass index, peri-operative blood loss and postoperative in-hospital mobility status showed univariate significance. Operating time had no significant univariate correlation with the occurrence of DVT, but was used for the final logistic regression model. In patients with postoperative PE, age, weight, body mass index, and a postoperative in-hospital bedridden status had univariate significance. An independent state after surgery had no significant univariate correlation with the occurrence of PE, but was used for the final logistic regression model. The univariate results for a VTE in general are also shown. For the final logistic regression model, age, weight, body mass index, blood loss, in-

Table 2

Postoperative in-hospital mobility status.

Mobility status	
Independent	34.6%
Dependent	41.7%
Wheelchair-bound	12.6%
Bedridden	11.1%

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