Use of Hemostatic Agents During Meningioma Resection: A Potential Risk Factor For Perioperative Thromboembolic Events

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Introduction

Hemostatic agents are widely used in patients undergoing intracranial tumor resection. These agents promote local hemostasis through activation of the clotting cascade (Figure 1), and may potentially activate systemic clotting resulting in thromboembolic events including deep venous thrombosis (DVT) and pulmonary embolism (PE). We performed a retrospective analysis to identify potential associations between hemostatic agent use and DVT/PE.

Methods

A single-institution review of patients undergoing craniotomy for meningioma from 2009-2012 was performed. Information on patient demographics, procedure duration, body mass index (BMI), estimated blood loss (EBL), tumor pathology, use of hemostatic matrix (FloSeal), and the presence of DVT/PE within 14 days of surgery was collected.

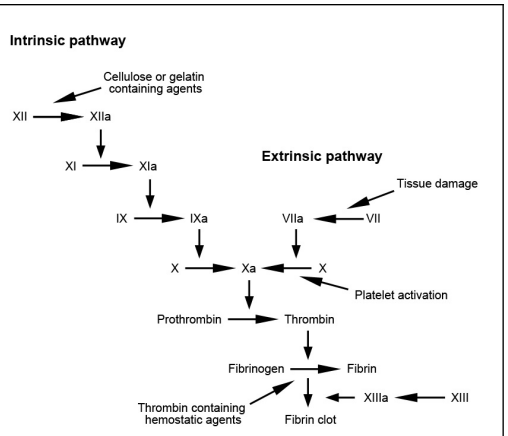

Figure 1. The coagulation cascade and hemostatic agents

Results

A total of 467 patients underwent a craniotomy for meningioma from 2009 -2012. There were 331 females and 136 males with a mean age of 58 ± 14 years (range 18-92) and a mean BMI of 28 ± 6. Tumor pathology included 359 grade I, 77 grade II, and 31 grade III tumors. There were 12 patients (2.6%) with thromboembolic events.

Table 1. Patient demographics

Clinical Parameter	Value (%) n=467
Age (years)	
Mean	58
Median	58
Range	18 - 92
Gender	
Male	331 (71%)
Female	136 (29%)
Body mass index	
Mean	28
Median	27
Range	16 – 61
Procedure duration (minutes)	
Mean	348
Median	308
Range	43 - 1125
Estimated blood loss (cc)	
Mean	354
Median	200
Range	10 - 3800
FloSeal	
≤10 ml	196 (42%)
>10 ml	271 (58%)
Tumor histology	
WHO grade I	359 (77%)
WHO grade II	77 (16%)
WHO grade III	31 (7%)
Thromboembolic event	
None within 14 days	455 (97%)
DVT/PE	12 (3%)

Results

Age (p=0.66), gender (p=0.33), EBL (p=0.99), and procedure duration (p=0.17) were not associated with an increased incidence of DVT/PE. Furthermore, use of DVT prophylaxis initiated 72 hours after surgery did not significantly alter the incidence of DVT/PE (p=0.20). BMI (p=0.04), tumor grade (p=0.05), and use of greater than 10 ml of a hemostatic agent intraoperatively (p=0.02) were associated with an increased incidence of DVT/PE. In a multivariate model, both BMI (OR=1.07, 95% CI: 1.00-1.15, p=0.048) and use of more than 10 ml of hemostatic agent (OR=8.03, CI: 1.02-63.40, p=0.048) were found to be significantly associated with the risk of DVT/PE.

Table 2. Univariate analysis of DVT/PE risk factors

Clinical parameter	No TE event (n=455)	DVT/PE (n=12)	p value
Age (years)	58	56	0.66[a]
Gender			
Male	131 (29%)	5 (42%)	0.33[b]
Female	324 (71%)	7 (58%)	
Body mass index	28	32	0.04[a]
Procedure duration (minutes)	346	454	0.17[a]
Estimated blood loss (ml)	354	352	0.99[a]
Tumor histology			
WHO grade I	352 (77%)	7 (58%)	0.05[b]
WHO grade II	72 (16%)	5 (42%)	
WHO grade III	31 (7%)	0 (0%)	
FloSeal			
≤10 ml	195 (43%)	1 (8%)	0.02[b]
>10 ml	260 (57%)	11 (92%)	
DVT prophylaxis			
Initiated at 72 hours	273 (60%)	5 (42%)	0.20[b]
None	182 (40%)	7 (58%)	

TE = thromboembolic event
[a] independent samples t test
[b] Chi-square test

Table 3. Multivariate analysis of DVT/PE risk factors

Variable	Odds Ratio (95% CI)	p value
Age	0.99 (0.95-1.03)	0.637
BMI	1.07 (1.00-1.15)	0.048
High-grade pathology	2.08 (0.62-6.94)	0.236
FloSeal > 10 ml	8.03 (1.02-63.40)	0.048

Conclusions

Hemostatic agents are valuable tools in modern neurosurgery, however their use may be associated with an increased risk of DVT/PE in patients undergoing meningioma resection. This finding provides the impetus for more definitive clinical and laboratory studies to characterize the biology of this association and helps identify patients at increased risk for thromboembolism. This study also affirms the association between high BMI and the risk of thromboembolism. Interestingly the use of prophylactic anticoagulation after surgery did not decrease the incidence of DVT/PE.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Describe the risk factors of peri-operative thromboembolic events, 2) Discuss the potential role of hemostatic agents in DVT/PE, 3) Identify future areas of investigation