Routine Anticoagulation in Spine Surgery Is Associated with Increased Complications Without VTE Reduction: A Propensity-Matched Analysis of Prospectively Collected Data

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INTRODUCTION: The routine use of anticoagulation (AC) in elective spine surgery remains debated and controversial, given the competing risks of venous thromboembolism (VTE)/pulmonary embolism (PE) and epidural hematoma. Prior retrospective studies have provided some insights but are limited by unclear anticoagulation criteria and inherent retrospective biases. Our institution's contrasting anticoagulation protocols between the Orthopedic and Neurosurgery services created a unique opportunity to evaluate outcomes using prospectively collected data.

METHODS: A prospectively collected multicenter database was queried for all patients treated at an academic tertiary care center from 2013-2023. 5014 patients were identified. After excluding patients with prior blood clots, hypercoagulability, or unclear anticoagulation status, Propensity score matching (PSM) based on age, gender, BMI, ASA grade, and diabetes history. Composite outcomes for overall and neurologic complications were created. T-tests and Chi-square tests were used for continuous and categorical variables respectively. Binary logistic regression was employed with Firth correction used for rare events.

RESULTS:

The final cohort included 2,420 patients equally divided between treatment (n = 1,210) and control (n = 1,210) groups, with balanced demographic and clinical characteristics. Cohorts were approx. 56% male, 78% white with mean age of 60.

Anticoagulated patients demonstrated higher rates of deep vein thrombosis (1.2% vs. 0.3%, p = 0.011) and wound dehiscence (2.3% vs. 1.0%, p = 0.011). New neurological deficits were more prevalent in the AC group, including weakness (12.9% vs. 8.5%, p < 0.001) and myelopathy (0.5% vs. 0%, p = 0.031). The AC group also experienced significantly higher rates of neurogenic bowel/bladder dysfunction (p < 0.001) and Urinary tract infection req catheter use (5.6% vs 2.9%, p = 0.002). Overall, complications were more frequent in AC patients (36.9% vs 32.4%, p = 0.021). Length of stay was prolonged in AC group (3.9 vs 2.0 days, p< 0.001) though 90-day readmission, reoperation, and mortality rates were comparable between groups.

Logistic regression identified key predictors of six postoperative complications following spine surgery. For any complication, longer time from surgery to discharge (OR 1.22, 95% CI 1.16–1.29, p < .001), coronary artery disease (OR 1.47, 95% CI 1.07–2.01, p = 0.018), and increasing age (OR 0.98, 95% CI 0.97–0.99, p < 0.001) were significant, while lumbar decompression was protective (OR 0.72, 95% CI 0.55–0.96, p = 0.023). For neurologic complications, time to discharge remained a strong predictor (OR 1.20, p < 0.001), and both lumbar fusion (OR 0.42, p < 0.001) and lumbar decompression (OR 0.34, p < 0.001) were protective.

Anticoagulant use was associated with increased odds of DVT (OR 4.16, 95% CI 1.16–22.00, p = 0.028) but was not associated with PE (p = 0.779). Absence of atrial fibrillation trended toward reduced PE risk (OR 0.13, 95% CI 0.02–1.15, p = 0.065). Wound dehiscence was predicted by elevated BMI (OR 1.08,95% CI 1.02–1.14 p = 0.014) and fibromyalgia (OR 4.14, 95% CI 1.26–13.66, p = 0.019). For hematoma requiring re-operation, time to discharge remained significant (OR 1.25, 95% CI 1.12–1.39, p < 0.001) with history of myocardial infarction demonstrated a strong trend toward increased risk (OR 4.62, 95% CI 0.97–21.91, p = 0.054).

DISCUSSION AND CONCLUSION: This study, utilizing dichotomous anticoagulation prescribing practices and prospectively collected outcomes, demonstrates that routine early anticoagulation is associated with increased complications across multiple metrics, largely neurological complications. Importantly, routine anticoagulation did not reduce the incidence of DVT or PE, underscoring the need for caution and individualized risk assessment when prescribing anticoagulation in elective spine surgery. Additionally, prolonged hospital stay emerged as a key predictor of adverse events, underscoring the need to facilitate timely and safe patient discharge.

Table 1: Patient Demographics Before and After Propensity Score Matching

Variable	No AC	AC Given	p-value	No AC (PSM)	AC Given (PSM)	p-value
N	2550	1945	-	1210	1210	-
Age (Mean ± SD)	54.71 ± 14.53	62.85 ± 12.53	**< 0.001**	60.29 ± 12.38	60.36 ± 12.00	0.898
BMI (Mean ± SD)	30.66 ± 6.54	30.97 ± 6.72	0.111	31.31 ± 6.71	31.30 ± 6.91	0.555
Gender (% Male)	1400 (54.9%)	1109 (57.0%)	0.157	667 (55.1%)	684 (56.5%)	0.256
Race			0.058			0.603
- White	2039 (80.0%)	1514 (77.8%)		961 (79.4%)	923 (76.3%)	
- Black/African American	130 (5.1%)	124 (6.4%)		70 (5.8%)	84 (6.9%)	
- Asian	40 (1.6%)	18 (0.9%)		12 (1.0%)	10 (0.8%)	
- Hispanic/Latino	35 (1.4%)	28 (1.4%)		17 (1.4%)	18 (1.5%)	
- Other	66 (2.6%)	37 (1.9%)		29 (2.4%)	22 (1.8%)	
ASA Grading			**< 0.001**			0.683
- Low risk (ASA 1/2)	1284 (50.4%)	619 (31.8%)		343 (28.4%)	333 (27.5%)	
- High risk (ASA 3/4)	1265 (49.6%)	1326 (68.2%)		867 (71.7%)	877 (72.5%)	
Smoking Status			**< 0.001**			0.143
- Current Smoker	336 (13.2%)	172 (8.8%)		136 (11.2%)	118 (9.8%)	
- Former Smoker	778 (30.5%)	697 (35.8%)		433 (35.8%)	438 (36.2%)	
- Never Smoker	1021 (40.0%)	654 (33.6%)		448 (37.0%)	376 (31.1%)	
Diabetes (% Yes)	438 (17.2%)	459 (23.6%)	**< 0.001**	281 (23.2%)	315 (26.0%)	0.119
Prescription Anticoagulation Use (% Yes)	106 (4.2%)	130 (6.7%)	**< 0.001**	71 (5.9%)	71 (5.9%)	0.862
Index Procedure			**< 0.001**			1.000
- Cervical Fusion	675 (26.5%)	581 (29.9%)		384 (31.7%)	384 (31.7%)	
- Cervical Decompression	161 (6.3%)	46 (2.4%)		12 (1.0%)	13 (1.0%)	
- Other Cervical	30 (1.2%)	6 (0.3%)		«	»	
- Lumbar Fusion	503 (19.7%)	821 (42.2%)		467 (38.6%)	467 (38.6%)	
- Lumbar Decompression	1176 (46.1%)	489 (25.1%)		347 (28.7%)	347 (28.7%)	
- Other Lumbar	5 (0.2%)	2 (0.1%)		«	»	

Table 2: Comparison of Postoperative Complications Between Anticoagulated and Non-Anticoagulated Groups

	Outcome	AC Group (N/%)	Non-AC Group (N/%)	p-value
Composite	Any Complication	446 (36.9%)	392 (32.4%)	**0.021**
	Neurologic Complication	162 (13.4%)	103 (8.5%)	**<.001**
Neurologic Complications	Myelopathy	6 (0.5%)	0 (0%)	**0.031**
	Bowel/Bladder Dysfunction	16 (1.3%)	1 (0.1%)	**<.001**
	New Neurologic Deficit	1 (0.1%)	1 (0.1%)	1.000
	Weakness	156 (12.9%)	103 (8.5%)	**<.001**
	Neurogenic Claudication	0 (0%)	0 (0%)	x
	CSF Leak	38 (3.2%)	23 (1.9%)	0.051
Wound Complications	Hematoma Requiring Re-Op	8 (0.7%)	10 (0.8%)	0.636
	Wound Dehiscence	26 (2.3%)	12 (1.0%)	**0.011**
	Superficial SSI	24 (1.9%)	33 (2.7%)	0.753
	MRSA Infection	18 (1.5%)	29 (2.4%)	0.140
Infection/Urinary	UTI Requiring Catheter	64 (5.3%)	34 (2.8%)	**0.002**
Thromboembolic Events	DVT	15 (1.2%)	4 (0.3%)	**0.011**
	Pulmonary Embolism	4 (0.3%)	4 (0.3%)	1.000
Systemic	Ileus	23 (1.9%)	18 (1.5%)	0.431
	Dysphagia (n = 396)	26 (6.5%)	17 (4.3%)	0.161
Cardiopulmonary Events	Myocardial Infarction	1 (0.1%)	2 (0.2%)	0.563
	Death (90d)	1 (0.1%)	3 (0.2%)	0.625
Returns (90d)	Reoperations	47 (3.9%)	65 (5.4%)	0.636
	Readmissions	105 (8.7%)	110 (9.1%)	0.721
	ED/Observation Visits	66 (5.5%)	69 (5.7%)	0.394
Length of Stay (days)	Surgery to Discharge	3.93	2.02	**<0.001**

Table 3: Logistic Regression Summary for Postoperative Complications

Outcome	Predictor	OR	95% CI	p-value
Any Complication	Length of stay	1.22	1.16 – 1.29	**<.001**
	Coronary Artery Disease	1.47	1.07 – 2.01	**0.018**
	Procedure Type (ref = Cervical Fusion)			
	— Lumbar Decompression	0.72	0.55 – 0.96	**0.023**
	— Lumbar Fusion	0.82	0.64 – 1.05	0.122
	— Cervical Decompression	2.63	0.88 – 7.86	0.084
	Age	0.98	0.97 – 0.99	**<.001**
Neurologic Complication	Length of stay	1.2	1.14 – 1.28	**<.001**
	Coronary Artery Disease	0.63	0.36 – 1.08	0.093
	Procedure Type (ref = Cervical Fusion)			
	— Lumbar Fusion	0.42	0.30 – 0.60	**<.001**
	— Lumbar Decompression	0.34	0.21 – 0.54	**<.001**
	— Cervical Decompression	1.57	0.42 – 5.87	0.507
Deep Vein Thrombosis	Anticoagulant Use	4.16	1.16 – 22.00	**0.028**
Pulmonary Embolism	No Atrial Fibrillation	0.13	0.02 – 1.15	0.065
	Anticoagulant Use	0.78	0.13 – 5.05	0.779
Wound Dehiscence	BMI	1.08	1.02 – 1.14	**0.014**
	Fibromyalgia	4.14	1.26 – 13.66	**0.019**
Hematoma Requiring Re-operation	Length of stay	1.25	1.12-1.39	**<.001**
	Prior Myocardial Infarction	4.62	0.97 - 21.91	0.054