INTERNATIONAL JOURNAL of SPINE SURGERY

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Int J Spine Surg published online 20 June 2024
https://www.ijssurgery.com/content/early/2024/06/18/8606

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The International Journal of Spine Surgery
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International Journal of Spine Surgery Publish Ahead of Print, published on June 20, 2024 as doi:10.14444/8606

International Journal of Spine Surgery, Vol. 00, No. 0, 2024, pp. 1–8
https://doi.org/10.14444/8606
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Complications of Venous Thromboembolism Chemoprophylaxis in Lumbar Laminectomy With and Without Fusion

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ABSTRACT

Background: The benefit of chemoprophylaxis (CPX) agents in preventing venous thromboembolism must be weighed against potential risks. Current literature regarding the efficacy of CPX after laminectomies with or without fusion is limited, with no clear consensus to inform guidelines.

Objective: This study evaluated the association between CPX and surgical complications after lumbar laminectomy with and without fusion.

Study Design: Retrospective study of patients at a single large academic institution.

Methods: The medical records of patients who underwent lumbar laminectomies with or without lumbar fusion from 2018 to 2020 were reviewed for demographics, surgical characteristics, CPX agents, postoperative complications, epidural hematomas, and wound drainage. Patients receiving CPX (n = 316) were compared with patients not receiving CPX (n = 316) via t test following propensity score matching, and patients on CPX were further stratified by fusion status.

Results: The CPX group had higher body mass index and American Society of Anesthesiologists grades. Rates of venous thromboembolism, epidural hematomas, infections, postoperative incision and drainage, transfusions, wound dehiscence, and reoperation were not associated with CPX. Moist dressings were more frequent, and average days of drain duration were longer with CPX. Overall postoperative complication rate and length of stay (LOS) were greater with CPX. The fusion subgroup had a lower Charlson Comorbidity Index, had a lower American Society of Anesthesiologists grade, was younger, had more women, and underwent more minimally invasive laminectomies. While estimated blood loss, operative times, and LOS were significantly greater in the fusion group, there was no difference in rate of intraoperative and postoperative complications.

Conclusion: CPX after lumbar laminectomies with or without fusion was not associated with increased rates of epidural hematomas, wound complications, or reoperation. Patients receiving CPX had more postoperative cardiac complications, but it is possible that surgeons were more likely to prescribe CPX for higher-risk patients. They also had higher rates of ileus and moist dressings, greater LOS, and longer length of drain duration. Patients who underwent lumbar laminectomy with fusion on CPX tended to be lower risk yet incurred greater blood loss, operative times, LOS, cardiac complications, and hematomas/seromas than patients not undergoing fusion.

Clinical Relevance: This retrospective study compared surgical complications of lumbar laminectomies in patients who received chemoprophylaxis vs patients who did not. Chemoprophylaxis was not associated with increased rates of epidural hematomas, wound complications, or reoperation, but it was associated with higher rates of postoperative cardiac complications and ileus.

Level of Evidence: 3.

Lumbar Spine

Keywords: Venous thromboembolism, chemoprophylaxis, lumbar laminectomy, surgical complications, fusion, epidural hematoma, wound dehiscence, length of stay, infection, blood loss, cardiac complications, ileus

KEY POINTS

- Chemoprophylaxis (CPX) in lumbar laminectomy patients was not associated with increased rates of epidural hematomas, venous thromboembolism, wound complications, infection, reoperation at 30 or 90 days, or transfusion.
- CPX was associated with higher rates of postoperative cardiac complications and ileus, as well as moist wounds or dressings.

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- Among those receiving CPX, patients who underwent lumbar laminectomy with fusion tended to be lower risk yet incurred greater blood loss, operative times, length of stay, cardiac complications, and hematomas/seromas than patients not undergoing fusion.

INTRODUCTION

Venous thromboembolisms (VTEs) are the leading cause of potentially preventable deaths in hospitalized patients and account for 100,000 patient deaths per year in the United States.[1–3] Given the mortality associated with VTEs, many fields, including trauma, plastics, and orthopedic surgery, have extensively explored this postsurgical complication.[4–8] However, within the subspecialty of orthopedic spine surgery, research is limited, and the incidence of VTE is poorly defined, with literature reporting numbers ranging from 0.3% to 31%.[9,10] This paucity of evidence is even more evident when focusing on specific spinal procedures, such as lumbar laminectomies and fusions.

While the use of chemoprophylaxis (CPX) in preventing VTE has been widely substantiated and poses an effective solution to this postoperative complication, many surgeons express concern regarding the use of CPX due to the possible complications that may arise.[11] Specifically, available literature emphasizes the need to carefully weigh the potential benefit of CPX in spine surgery against the potential risk of bleeding complications. Epidural hematoma can lead to neurological deficits, wound drainage, and infection.[10] No consensus exists in current literature regarding conditions in which CPX benefits may outweigh associated risks, meriting further investigation.[12–14]

This lack of consensus is also reflected at the level of current guidelines available to practicing spine surgeons. In 2009, the North American Spine Society concluded that there were not enough data available to properly analyze the risks and benefits associated with CPX use in patients undergoing spine surgery.[14] Similarly, in 2018, the Congress of Neurological Surgeons sought to assess the use of VTE prophylaxis in the treatment of thromboembolic events in relation to thoracic and lumbar spine fractures. Their study also concluded that there was insufficient evidence to provide recommendations regarding a specific superior VTE prophylaxis regimen with fewer complications.[13] The American College of Chest Physicians also acknowledges insufficient data regarding CPX following spine surgery, highlighting recent brain or spine injury as a risk factor for bleeding and a contraindication to the use of thrombolytic therapy.[3,15–19] Notably, the American Academy of Orthopedic Surgeons does not provide specific guidelines on thrombolytic therapy regarding spine surgery but does provide recommendations in reference to elective hip and knee arthroplasty.[20]

Given the paucity of current literature and guidelines regarding the risks and benefits of CPX use following spine surgery, surgeons are forced to recommend therapy without applicable evidence to guide their decision. As a result, current practice varies widely and is largely based on surgeons' preferences.[21,22] With the ultimate goal of informing a more evidence-based approach, the current study investigates the postoperative complications of CPX usage in specific spine surgeries, including laminectomies with and without fusion. We hypothesized that lumbar laminectomy patients receiving CPX would incur greater rates of transfusions, hematomas, and infections but lower rates of VTE.

METHODS

This study was a retrospective review of patients who underwent lumbar laminectomy indicated for central stenosis with or without fusion between 2018 and 2020 from a single academic medical center. Institutional Review Board (NYU Langone Health) approval was obtained at the study site prior to study initiation. Revision cases were excluded. The determination of CPX was not standardized and instead deferred to the surgeon's discretion. CPX of patients who were already on CPX prior to surgery was either stopped or bridged prior to surgery based on cardiology recommendations.

A medical record review was performed for demographics, surgical characteristics, CPX agents and dosages, intraoperative complications, postoperative complications, and surgical wound characteristics, including wound drainage and dehiscence. Patients with VTEs, transfusions, hematomas or seromas (superficial, deep, and/or epidural), infections (deep and/or superficial), and incision and drainage (I&D) procedures were identified using Current Procedural Terminology and International Classification of Diseases codes and verified with medical record review.

Statistical Analysis

Statistical analyses were performed using validated statistical software (SPSS, version 27.0.1, IBM, Armonk, NY, USA).

Patients in the CPX group were defined as patients receiving inpatient CPX starting on postoperative day

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Table 1. Demographics and surgical characteristics of patients who received chemoprophylaxis vs patients who did not.

	Inpatient Chemoprophylaxis		
Characteristics	**No (*n* = 316)**	**Yes (*n* = 316)**	***P***
Patient Demographics			
BMI	28.55 ± 7.79	29.72 ± 6.69	**0.042**
CCI	4.25 ± 2.50	4.15 ± 2.37	0.567
Age, y	65.31 ± 11.78	66.44 ± 12.31	0.239
ASA grade	2.39 ± 0.57	2.57 ± 0.58	**<0.001**
Gender (% woman)	152 (48.1%)	133 (42.1%)	0.129
Race			0.863
White	203 (64.2%)	206 (65.2%)	
African American	36 (11.4%)	30 (9.5%)	
Asian	24 (7.6%)	27 (8.5%)	
Other	53 (16.8%)	53 (16.8%)	
Payor type (% private)	209 (66.1%)	197 (62.3%)	0.113
Surgical Characteristics			
Fusion	213 (67.4%)	209 (66.1%)	0.736
Levels fused	0.97 ± 0.85	1.11 ± 1.01	0.056
Laminectomy upper vertebra	22.28 ± 1.02	22.25 ± 0.997	0.723
Laminectomy lower vertebra	23.93 ± 2.070	24.14 ± 1.58	0.447
MIS vs open (% open)	25 (7.9%)	14 (4.4%)	0.069
EBL, mL	237.22 ± 274.03	281.50 ± 310.92	0.058
Operative time, min	209.87 ± 86.32	213.37 ± 88.24	0.614
Intraoperative complications	14 (4.4%)	25 (7.9%)	0.069

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; CCI, cranial cervical instability; EBL, estimated blood loss; MIS, minimally invasive surgery.
Note: Data presented as mean ± SD or *n* (%). Bolded values are statistically significant ($P < 0.05$).

(POD) 0 or greater. Patients in the no CPX group did not receive inpatient CPX postoperatively. Propensity score matching controlled for operative time and cranial cervical instability (CCI). Statistical analyses with *t* tests were performed for variables including demographics, surgical characteristics, infections, hematomas, transfusions, wound drainage, and other postoperative complications in relation to CPX usage. Significance was set at an alpha of 0.05 a priori.

RESULTS

Demographics and Surgical Characteristics

An initial query from a single academic medical center identified 890 patients who underwent lumbar laminectomy with or without fusion between 2018 and 2020. Propensity score matching was subsequently conducted to control for operating time and CCI, isolating a total of 632 patients (n = 316 CPX and n = 316 no CPX). The resulting study and control cohorts showed no significant differences in demographics with regard to CCI, age, gender, race, and payor type, as shown in Table 1. Mean body mass index (BMI) was notably higher in the CPX cohort compared with the no CPX cohort (29.72 ± 6.69 vs 28.55 ± 7.79; $P = 0.042$), as were mean American Society of Anesthesiologists (ASA) grades (29.72 ± 6.69 vs 28.55 ± 7.79; $P = 0.042$). Additionally, both cohorts showed no differences in surgical characteristics, which included rates of fusion, levels fused, laminectomy levels, minimally invasive vs open surgery, estimated blood loss, operation time, intraoperative complications, and transfusions. The majority of the CPX cohort was treated with enoxaparin (66.0%), followed by aspirin (29.7%), heparin (3.3%), and apixaban (1.0%). Postoperative day of initiation of CPX ranged from 83.6% on POD 1; 6.2% on POD 0; 5.3% on POD 2; 2.4% on POD 3; 1.0% on POD 4; 0.5% on POD 5; to 0.5% on POD 9.

Rates of Epidural Hematoma and Wound Complications

No significant differences were observed between CPX and no CPX groups in rates of overall hematomas/seromas (1.3% vs 1.3 %; $P = 1.000$), superficial hematomas/seromas (0.3% vs 0.3 %; $P = 1.000$), deep hematomas/seromas (0.9% vs 0.6 %; $P = 0.653$), or canal/epidural hematomas/seromas (0.0% vs 0.3 %; $P = 0.317$), as shown in Table 2. POD of all hematomas/seromas development also showed no significant differences between CPX and no CPX groups (37.67 ± 47.48 vs 35.50 ± 33.56; $P = 0.946$).

Rates of postoperative I&D were not correlated to CPX (0.6% vs 0.6 %; $P = 1.000$), as shown in Table 3. POD of I&D also showed no significant differences between the CPX and no CPX groups (13.00 ± 11.31 days vs 13.00 ± 11.31 days; $P = 0.563$). Moist wounds or dressings were more frequent in the CPX group (39.6%

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Table 2. Hematoma/seroma development, I&D, and wound dehiscence in patients who received vs did not receive chemoprophylaxis.

	Inpatient Chemoprophylaxis		
Hematomas/Seromas, I&D, and Wound Dehiscence	**No (*n* = 316)**	**Yes (*n* = 316)**	***P***
All hematomas/seroma	4 (1.3%)	4 (1.3%)	>0.99
Superficial seromas/hematomas	1 (0.3%)	1 (0.3%)	>0.99
Deep seromas/hematomas	2 (0.6%)	3 (0.9%)	0.653
Canal/epidural hematomas	1 (0.3%)	0 (0.0%)	0.317
All hematomas/seromas diagnosis date (POD)	35.50 ± 33.56	37.67 ± 47.48	0.946
I&D procedure	2 (0.6%)	2 (0.6%)	>0.99
Date of I&D (POD)	37.00 ± 48.08	13.00 ± 11.31	0.563
Wound dehiscence	0 (0.0%)	0 (0.0%)	-
Moist wound or dressing	80 (25.3%)	125 (39.6%)	**<0.001**
Avg drain duration, d	3.77 ± 2.74	4.60 ± 1.953	**<0.001**
Avg daily drainage, mL	146.96 ± 96.35	157.64 ± 104.13	0.238

Abbreviations: I&D, incision and drainage; POD, postoperative day.
Note: Data presented as mean ± SD or *n* (%). Bolded values are statistically significant ($P < 0.05$).

vs 25.3%; $P < 0.001$), whereas no differences were seen in wound dehiscence or earliest date of wound dehiscence observed between the 2 groups. Average number of days of drain duration were significantly higher in the CPX group compared with the no CPX group (4.60 ± 1.95 vs 3.77 ± 2.74; $P < 0.001$), whereas average daily drainage was not significantly different (157.64 ± 104.13 vs 146.96 ± 96.35; $P = 0.238$).

Rates of VTE, Infection, and Transfusions

Overall VTE rates were not significantly different between the CPX and no CPX groups (0.9% vs 2.5%; $P = 0.128$), as shown in Table 4. POD of VTE initial diagnosis was also not significantly different between groups (18.33 ± 15.37 vs 8.88 ± 7.51; $P = 0.469$). All VTEs resolved after treatment, with an average treatment duration of 55 days. Common treatment medications were rivaroxaban (64%), heparin (36%), and apixaban (36%). Rates of overall infection, superficial surgical site infection, and deep surgical site infection showed no relationship to CPX use ($P > 0.05$). Additionally, rates of intraoperative and postoperative transfusions were not associated with CPX ($P > 0.05$).

Rates of Postoperative Complications

The overall postoperative complication rate was greater in the CPX group compared with the no CPX group (22.2% vs 11.7%; $P < 0.001$), as shown in Table 5. This was attributable to significantly greater rates of postoperative cardiac complications (7% vs 1.9%; $P = 0.002$) and ileus (4.1% vs 0.9%; $P = 0.011$) in the CPX group. Length of stay (LOS) was greater in the CPX group when compared with the no CPX group (4.07 ± 2.66 vs 2.97 ± 2.73 days; $P < 0.001$). Rates of reoperation at 30 and 90 days were not significantly different between the 2 cohorts.

Fusion vs No Fusion

We evaluated the CPX patients for differences between laminectomy only and laminectomy with fusion, as shown in Table 6. Of the 316 CPX patients, 209 underwent lumbar laminectomy with fusion, while 107 underwent lumbar laminectomy without fusion. No significant differences in BMI or race existed between the groups. Notably, the fusion group had a lower Charlson Comorbidity Index (3.82 ± 2.28 vs 4.79 ± 2.41; $P = 0.001$) and ASA grade (2.46 ± 0.546 vs 2.77 ± 0.592;

Table 3. Rates of VTE, infection, and transfusions in patients who received vs did not receive chemoprophylaxis.

	Inpatient Chemoprophylaxis		
Rates of VTE, Infection, and Transfusions	**No (*n* = 316)**	**Yes (*n* = 316)**	***P***
Postoperative transfusion	5 (1.6%)	12 (3.8%)	0.085
Intraoperative transfusion	6 (1.9%)	8 (2.5%)	0.589
VTE (%)	3 (0.9%)	8 (2.5%)	0.128
POD of first VTE diagnosis	18.33 ± 15.37	8.88 ± 7.51	0.469
All infections[a]	6 (1.9%)	9 (2.8%)	0.433
Superficial SSI	1 (0.3%)	3 (0.9%)	0.316
Deep SSI	6 (1.9%)	8 (2.5%)	0.589

Abbreviations: POD, postoperative day; SSI, surgical site infection; VTE, venous thromboembolism.
Note: Data presented as mean ± SD or *n* (%).
[a]Some patients had both superficial and deep SSIs.

Table 4. Rates of postoperative complications in patients who received vs did not receive chemoprophylaxis.

	Inpatient Chemoprophylaxis		
Postoperative Complications	**No (*n* = 316)**	**Yes (*n* = 316)**	***P***
Overall rates	37 (11.7%)	70 (22.2%)	**<0.001**
Cardiac	6 (1.9%)	22 (7.0%)	**0.002**
Neurologic	9 (2.8%)	15 (4.7%)	0.212
Pulmonary	3 (0.9%)	6 (1.9%)	0.314
Airway edema	1 (0.3%)	0 (0.0%)	0.317
Ileus	3 (0.9%)	13 (4.1%)	**0.011**
Urinary	9 (2.8%)	13 (4.1%)	0.385
Death	0 (0.0%)	0 (0.0%)	-
Mechanical	0 (0.0%)	0 (0.0%)	-

Note: Data presented as mean ± SD or *n* (%). Bolded values are statistically significant ($P < 0.05$).

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Table 5. Demographics and postoperative outcomes in patients on chemoprophylaxis who underwent laminectomy with fusion vs without fusion.

	Fusion		
Demographics and Outcomes	**No (*n* = 107)**	**Yes (*n* = 209)**	***P***
Patient Demographics			
BMI	29.94 ± 5.93	29.62 ± 7.06	0.669
CCI	4.79 ± 2.41	3.82 ± 2.28	0.001
Age, y	69.76 ± 13.37	64.74 ± 11.39	0.001
ASA grade	2.77 ± 0.592	2.46 ± 0.546	0.001
Female gender	28 (26.0%)	104 (50.0%)	0.001
Race			0.756
White	68 (63.6%)	138 (66.0%)	
African American	10 (9.3%)	20 (9.6%)	
Asian	9 (8.4%)	18 (8.6%)	
Other	20 (18.7%)	33 (15.8%)	
Payor type (% private)	58 (54.2%)	139 (66.5%)	0.036
Levels fused	0 ± 0	1.68 ± 0.763	
MIS vs open laminectomy (% open)	1 (0.90%)	13 (6.20%)	0.006
EBL (mL)	163.64 ± 196.983	341.84 ± 340.332	0.001
Op time (min)	155.78 ± 66.097	242.86 ± 83.573	0.001
Postoperative Outcomes			
Length of stay, d	3.50 ± 3.01	4.37 ± 2.42	0.011
Return to OR in 30 d	5 (4.7%)	3 (1.4%)	0.145
Return to OR in 90 d	1 (0.9%)	8 (3.8%)	0.076
Cardiac complications	3 (2.8%)	19 (9.1%)	0.015
Venous thromboembolism	7 (6.5%)	11 (5.3%)	0.353
All hematomas/seromas	0 (0.0%)	4 (1.9%)	0.045
Incision and drainage procedure	2 (1.9%)	0 (0.0%)	0.158
All infections	6 (5.6%)	3 (1.4%)	0.082

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; CCI, cranial cervical instability; EBL, estimated blood loss; LOS, length of stay; MIS, minimally invasive surgery; OR, operating room; VTE, venous thromboembolism.
Note: Data presented as mean ± SD or *n* (%).

P = 0.001) than the no fusion group. The fusion group was younger (64.74 ± 11.39 vs 69.76 ± 13.37 years old; *P* = 0.001) and had more women (50.0% vs 26.0%; *P* = 0.001). The fusion group underwent more upper vertebra (22.49 ± 0.931 vs 21.78 ± 0.955; *P* = 0.001) as well as minimally invasive (6.2% vs 0.9%; *P* = 0.006) laminectomies.

While estimated blood loss (341.84 ± 340.332 vs 163.64 ± 196.983 mL; *P* = 0.001), operative times (242.86 ± 83.573 vs 155.78 ± 66.097 minutes; *P* = 0.001), and LOS (4.37 ± 2.42 vs 3.50 ± 3.01 days; *P* = 0.011) were significantly greater in the fusion group, there was no difference in the rate of intraoperative and postoperative complications (including VTE and infection) or transfusions. However, there were significantly more cardiac postoperative complications (9.1% vs 2.8%; *P* = 0.015) as well as hematomas/seromas (1.9% vs 0.0%; *P* = 0.045) in the fusion group. The average drain duration was significantly longer in the fusion group (4.88 ± 1.782 vs 4.01 ± 2.170 days; *P* < 0.001), and the average daily drainage was greater (179.89 ± 111.971 vs 110.31 ± 63.318 mL; *P* < 0.001). There was no difference in the postoperative days of CPX initiation. In the fusion group, 66% of patients were on enoxaparin, 29.7% aspirin, 3.3% heparin, and 1% apixaban. In the no-fusion group, 47.7% of patients were on enoxaparin, 47.7% aspirin, 1.9% heparin, 0.9% rivaroxaban, and 0.9% warfarin.

DISCUSSION

Investigation of the potential risks associated with CPX agents is of critical importance given the current lack of consensus on VTE prevention guidelines in spine surgery. This study evaluated the association between CPX and rates of hematomas and wound complications in lumbar laminectomy patients with and without fusions. Our study found that CPX usage is not associated with rates of wound complications, VTE, or transfusion. CPX usage was associated with a higher rate of postoperative cardiac and ileus complications as well as LOS. While prior studies in joint replacement have found higher infection and hematoma incidence with CPX,[23,24] the current literature in spine surgery is far less robust. In line with these trends found in joint replacement, we also found that moist wounds or dressings were more often seen in the CPX group. However, infection and epidural hematoma rates were not related to CPX use.

Epidural hematomas and subsequent neurological decline are concerning complications among spine surgeons considering CPX in their patients. Our study

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reports an overall epidural hematoma incidence of 0.2% following lumbar laminectomy. Although this value is statistically insignificant, it is consistent with current studies that have reported the incidence of epidural hematomas following spine surgery between 0% and 0.9%.[25,26] Specifically, Glotzbecker et al conducted a systematic review in 2011 of 16 studies and found incidences of epidural hematomas in patients who received anticoagulation to range between 0% and 0.7% vs 0% and 1% among all studies. Moreover, our study found no statistical difference in rates of epidural hematoma and rates of all hematomas/seromas between CPX and no CPX groups. Similarly, Glotzbecker et al calculated incidences of epidural hematomas with and without prophylaxis to be 0.4% and 0.2%, respectively.[27] A recent study conducted by Dhillon et al compared a total of 6869 spine surgical procedures and found epidural hematoma rates of 0.21% (n = 4) in patients receiving CPX vs 0.18% (n = 9) in patients who did not (P = 0.622).[28] Given that our study results show no statistical difference in rates of epidural hematoma between CPX and no CPX groups, our data are supported by these limited findings.

Our study also showed that the time between date of operation and discovery of hematoma was not related to CPX usage. This is consistent with the aforementioned study conducted by Dhillon et al, which found that epidural hematomas were first diagnosed on POD 10.84 in CPX patients and on POD 6.17 in no CPX patients (P = 0.736).[28] Notably, the findings of Dhillon et al are in reference to epidural hematomas following spinal procedures, whereas our study references lumbar laminectomies specifically.

When considering rates of VTE following lumbar laminectomies, our data showed an overall incidence of 1.7%. Overall VTE rates were not significantly different between the CPX and no CPX cohorts. These findings are consistent with that of a second systematic review by Glotzbecker et al,[27] which incorporated data from 9485 patients across 25 different studies and found the incidence of VTE following spine surgery to range between 0.3% and 31%. While no individual studies demonstrated a decrease in rates of DVT with CPX, the subanalysis of CPX patients demonstrated a potential decrease of DVT rate to 0.6%.[29–31] Notably, Glotzbecker et al did not control for variation in the relative magnitude of surgery (eg, multilevel procedures) or approach, which our current study does. To provide greater resolution based on specific spine surgery procedure, we also evaluated the CPX patients for differences between laminectomy only and laminectomy with fusion surgeries. We found that patients who underwent lumbar laminectomy with fusion on CPX tended to be lower risk (lower CCI and ASA, younger, more minimally invasive procedures) yet incurred greater blood loss, operative times, LOS, cardiac complications, and hematomas/seromas than patients who did not undergo fusion.

Our study also showed that overall postoperative complication rates were greater in patients receiving CPX compared with those patients who were not, driven by cardiac complications and ileus. It is important to consider these outcomes with the differences between our CPX and no CPX cohort in mind, specifically BMI and ASA grade. Considering that CPX was not standardized in this study, it is feasible that surgeons may have been more inclined to give higher risk patients CPX, contributing to cardiac complications seen in this group. CPX is also used more frequently in anterior lumbar approaches, which may explain the higher rates of ileus.

Notably, BMI is a risk factor for cardiac complication rates following spine surgery. Zhang et al conducted a meta-analysis of 7 studies exploring postoperative outcomes of cervical fusion procedures and found BMI to be associated with a higher postoperative rate of cardiac complications.[32] In contrast, several studies have failed to reach a consensus on whether BMI is associated with postoperative ileus following elective spine surgery.[33–35] Our study also found LOS to be greater in the CPX group when compared with the no CPX group, which may be explained by these postoperative complications.

This study is not without limitations. Retrospective studies do not allow for randomization and therefore incur a risk of selection bias. Additionally, given that the study was conducted at a single academic center, the influence of institution-specific protocols as well as surgeon discretion and skill should also be considered. A related key limitation is our modest sample size, especially given the rarity of our primary event of interest, epidural hematoma. Specifically, we were unable to conduct a multivariate analysis on complications by specific CPX agent prescribed because the subsample sizes would be very small, and several confounding factors (including surgeon preference and institution-specific protocols) likely influenced the selection of specific agents. Finally, this study did not address the question of when to start postoperative CPX, which is a pertinent question for many spine surgeons and should be addressed in future studies.

CONCLUSION

Our study demonstrated that, in patients with lumbar laminectomies with or without fusion, postoperative VTE CPX is not associated with increased rates of epidural hematomas, wound complications, or reoperation at 30 or

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90 days. Overall rates of VTE, infection, and transfusion were also not related to CPX usage. In contrast, CPX usage was associated with a higher rate of postoperative cardiac complications and ileus, as well as moist wounds or dressings. Patients who underwent lumbar laminectomy with fusion on CPX tended to be lower risk yet incurred greater blood loss, operative times, LOS, cardiac complications, and hematomas/seromas than patients who did not undergo fusion. This study, though not without its limitations, can be used to inform CPX regimens and direct policy makers and providers when implementing changes in the management of lumbar laminectomy patients. Additional studies with a greater sample size should be pursued to better understand the relationships between lumbar laminectomies and postoperative VTE CPX with regard to postoperative complications.

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Funding: The authors received no financial support for the research, authorship, and/or publication of this article.

Declaration of Conflicting Interests: Themistocles Protopsaltis reports royalties/licenses from Altus; consulting fees from Globus, Nuvasive, Medtronic, Stryker, and K2M; and stock/stock options from OnPoint Surgical. The remaining authors have nothing to report.

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