

# Intraoperative Venous Injury during Anterior Lumbar Interbody Fusion: Incidence, Risk Factors, and Complications

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## INTRODUCTION:

Anterior lumbar interbody fusion (ALIF) requires manipulation of the iliac vessels, making venous injury a known complication. Prior studies have reported a wide-ranging incidence of venous injury (0.3%-24%), likely due to small sample sizes. Given the growing number of spine surgeons performing their own approaches, understanding the true incidence, risk factors, and complications of venous injury is essential for appropriate patient selection and perioperative management. Therefore, this study aims to evaluate the incidence, independent risk factors, and postoperative complications associated with venous injury during ALIF.

## METHODS:

This retrospective review included patients who underwent one- to four-level ALIF at an academic spine center. Patients <18 years old or those with surgical indications for trauma, infection, or malignancy were excluded. Patients were stratified by the presence or absence of venous injury that required primary repair with suture. Multivariable logistic regression analyses were used to assess independent predictors and postoperative complication risks, adjusting for demographic and surgical covariates.

## RESULTS:

Among 554 patients, 92 (16.61%) sustained a venous injury. The most frequently injured vein was the left common iliac vein (82.61%), followed by the iliolumbar vein (6.52%), inferior vena cava (4.35%), left internal iliac vein (3.26%), right common iliac vein (2.17%), and left external iliac vein (1.09%). Multivariable logistic regression identified independent predictors of venous laceration, including age (aOR: 1.03, [1.002-1.05], p<0.01), chronic kidney disease (CKD) (aOR: 5.17, [1.57-17.04], p<0.01), ALIF at L4-5 (aOR: 3.88, [1.59-9.46], p<0.01), and two-level ALIF (aOR: 1.70, [1.15-2.51], p<0.01)(Figure 1). Notably, ALIF at L5-S1 was protective (aOR: 0.24, [0.09-0.57], p<0.001). Patients with venous injury had significantly longer operative times (8.02±2.95 vs. 6.48±2.81 hours, p<0.001) and greater mean blood loss (1,271±1607.60 mL vs. 600.71±1150.06 mL, p<0.001)(Table 1). Multivariable logistic regression analysis identified venous injury as independent risk factor for deep vein thrombosis (aOR: 3.33, [1.32-8.40], p=0.011), intraoperative transfusion (aOR: 4.43, [2.51-7.82], p<0.001), and the need for incision and drainage (aOR:7.45, [1.75-31.62], p<0.01)(Figure 2).

## DISCUSSION AND CONCLUSION:

Venous injury during ALIF occurred in 16.61% of cases, with independent risk factors including age, CKD, L4-5 ALIF, and two-level ALIF. These injuries were associated with significantly prolonged operative times and a markedly elevated risk of DVT. Future research should focus on developing risk reduction strategies for high-risk patients and developing evidence-based DVT prophylaxis protocols tailored to patients with venous injuries.

Figure 1: Forest Plot of Predictors of Venous Injury

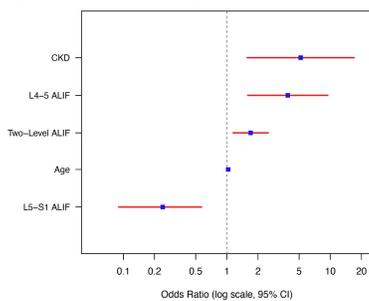


Figure 2: Forest Plot of Complications Associated with Venous Injury

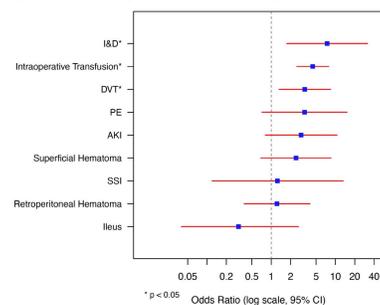


Table 1: Univariate and Multivariable logistic regression analysis for postoperative complications associated with injury

	No Venous Injury	Venous Injury	OR	95% CI	p-value	OR	95% CI	p-value
Duration of Surgery (Hours)	6,482 (91)	8,022 (92)	-	-	-	-	-	-
OR (log scale)	608.71 (1.04)	1,071.09 (1.04)	-	-	-	-	-	-
OR	-	-	1.68	1.52-1.85	<0.001	-	-	-
Deep Vein Thrombosis	1 (0.1%)	4 (4.3%)	4.43	1.32-14.41	0.011	3.33	1.32-8.40	0.011
OR (log scale)	1 (0.1%)	4 (4.3%)	4.43	1.32-14.41	0.011	3.33	1.32-8.40	0.011
OR	-	-	4.43	2.51-7.82	<0.001	4.43	2.51-7.82	<0.001
Intraoperative Transfusion	1 (0.1%)	26 (28.3%)	2.88	0.95-8.82	0.06	2.43	0.88-6.51	0.11
OR (log scale)	1 (0.1%)	26 (28.3%)	2.88	0.95-8.82	0.06	2.43	0.88-6.51	0.11
OR	-	-	2.88	1.75-4.75	<0.001	7.45	1.75-31.62	<0.01
Incision and Drainage	1 (0.1%)	11 (12%)	1.28	0.44-3.56	0.64	1.22	0.32-4.39	0.81
OR (log scale)	1 (0.1%)	11 (12%)	1.28	0.44-3.56	0.64	1.22	0.32-4.39	0.81
OR	-	-	1.28	1.75-24.94	0.01	7.45	1.75-31.62	<0.01

OR=Odds Ratio, 95% CI=95% Confidence Interval, p<0.05 considered statistically significant.