High Altitude is an Independent Risk Factor for Postoperative Venous Thromboembolism Following Primary TKA

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INTRODUCTION:

Venous thromboembolism (VTE) is a potentially fatal complication following TKA. High altitude can create physiological changes for patients undergoing TKA and predispose them to a VTE event. The purpose of this study was to determine if high altitude is an independent risk factor for postoperative VTE event following TKA.

METHODS:

The PearlDiver Mariner database was queried for patients who underwent TKA at high-elevation (≥4000 ft) and low-elevation (≤100 ft) using Current Procedural Terminology (CPT) codes, International Classification of Disease (ICD) codes, and zip-codes. High and low-altitude cohorts were matched 1:3 by 5-year age range, gender, Charlson comorbidity index (CCI), and 4 common comorbidities that predispose VTE: diabetes mellitus, obesity (BMI ≥30), hypertension, and tobacco use. Outcome measures included 30- and 90-day incidence of overall VTE, deep venous thrombosis (DVT), and pulmonary embolism (PE). Pearson chi-squared tests were performed to extract demographics and determine the significance between cohorts. Binomial logistic regression analysis was used to determine the differences in incidence of postoperative VTE, DVT, and PE between cohorts and the odds ratios (OR). $P < 0.05$ was considered statistically significant.

RESULTS:

228,457 patients met the inclusion criteria after matching. There were 57,135 in the high-altitude group and 171,322 in the low altitude group.(Table 1) The incidence of VTE within 30-days of TKA was significantly higher for the high-altitude group compared to the low-altitude group (OR 1.15 [95% CI 1.02-1.30], P = 0.022), as well as within 90-days (OR 1.20 [95% CI 1.08-1.34], P = 0.0007).(Table 2) The incidence of DVT was significantly higher for the high-altitude cohort at both 30- and 90-days postoperatively (OR 1.30 [95% CI 1.10-1.54], P = 0.002), (OR 1.36 [95% CI 1.18-1.57], P < 0.0001). The incidence of PE within 30- and 90-days did not reach statistical significance between groups.

DISCUSSION AND CONCLUSION:

In this large database study, high altitude was identified as an independent risk factor for VTE following TKA. Patients who undergo TKA at 4000 feet in elevation or more were more likely to develop VTE at 30 days (OR 1.20 p=0.022) and 90 days (OR 1.2 p=0.007 and DVT both in the 30-(OR 1.3 p=0.002) and 90 (OR 1.36 p<0.0001)-day postoperative period.

Patient Demographics	High altitude (≥4000 ft)	Low altitude (≤100 ft)	*P*-value
Total, N	57,135	171,322	
Age Range, N (%)			
<65	22,402 (39.2)	67,161 (39.2)	0.979
65-69	11,635 (20.4)	34,894 (20.4)	0.991
70-74	12,902 (22.6)	38,698 (22.6)	0.980
>75	7,716 (13.5)	23,255 (13.5)	0.682
Gender, N (%)			
Male	22,238 (38.9)	66,668 (38.9)	0.977
Female	34,897 (61.1)	104,654 (61.1)	
Comorbidities, N (%)			
Diabetes Mellitus	23,814 (41.7)	71,412 (41.7)	0.995
Obesity (BMI ≥ 30)	28,909 (50.6))	86,679 (50.6)	0.992
Hypertension	48,266 (84.5)	144,763 (84.5)	0.912
Tobacco Use	20,464 (35.8)	61,348 (35.8)	0.975

	≥4000 ft, N (%)	≤ 100 ft, N (%)	OR [95% CI]	*P*-value
Total Patients	57,135	171,322	-	-
30 days postoperatively				
VTE	363 (0.64)	945 (0.55)	1.15 [1.02-1.30]	**0.022**
DVT	197 (0.34)	454 (0.26)	1.30 [1.10-1.54]	**0.002**
PE	183 (0.32)	528 (0.31)	1.04 [0.88-1.23]	0.653
90 days postoperatively				
VTE	502 (0.81)	401 (0.65)	1.20 [1.08-1.33]	**0.0007**
DVT	270 (0.47)	595 (0.35)	1.36 [1.18-1.57]	**< 0.0001**
PE	238 (0.42)	667 (0.39)	1.07 [0.92-1.24]	0.370