The Influence of COVID-19 on the Rate of Symptomatic Deep Vein Thrombosis Following Foot and Ankle Surgery

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Introduction

There is a known correlation with the COVID-19 virus and the creation of a hypercoagulable and prothrombotic state that increases the risk of thrombotic events[1]. To this point, Chang et al. demonstrated a greater incidence of deep venous thrombosis (DVT) in COVID-19 patients versus non-COVID-19 patients[2]. The hallmark of COVID-19 is a cytokine storm that is characterized by high levels of inflammatory markers which activate platelets and monocytes, cause endothelial inflammation, and activate the tissue factor VIIa pathway leading to formation of immunologically mediated thrombi[3,4].

There is limited research evaluating the incidence of DVT in patients undergoing operative intervention with a perioperative COVID-19 diagnosis. To the best of the authors knowledge there is no publication investigating the incidence and risk factors surrounding DVT in COVID-19 positive patients following foot and ankle surgery. The purpose of this publication is to evaluate the incidence of DVT among COVID-19 positive patients undergoing foot and ankle surgery and assess pertinent perioperative factors which may increase the risk of DVT in these patients. We hypothesized that patients who undergo foot and ankle surgical intervention would not be at an increased risk of symptomatic DVT dependent on recent, current, or postoperative COVID-19 diagnosis.

Methods

A retrospective study was performed utilizing patients within the authors institution. After institutional review board approval, a query pulled patients who had foot or ankle surgery from March 23, 2020, through July 31, 2022. The date of March 23, 2020, was utilized as this date correlated with the beginning of the COVID-19 pandemic in the authors geographical region. Data extraction was performed for patients who met the inclusion and exclusion criteria. Patients must have been 18 years of age or older at the time of surgical intervention and must have had foot and ankle surgery during the above-mentioned time frame. Patients must also have had a COVID-19 diagnosis at some point during the data pull, even if not associated with the perioperative period. The COVID diagnosis perioperative period was defined as recent (10 -120 days before surgery), current (<10 days before surgery), and postoperative (<30 days after surgery). All other patients were classified as “No COVID” during the perioperative period. Patients were excluded if they had surgery to any other anatomical location outside of the foot and ankle concomitantly. Patient demographics, medical history including comorbidities, surgery type and date, date and timing of COVID, and incidence of DVT were all recorded.

Statistical Analysis

All data was analyzed using JASP 0.17.1 and Jamovi 2.3.21.0. Descriptives were calculated for all variables. Means and standard deviations were utilized to describe continuous variables and counts and percentages were utilized to describe categorical variables. Comparisons between groups were made utilizing independent samples T-tests for continuous variables and Chi-Squared tests for categorical variables. Statistical significance was set at ≤ 0.050 a priori.

Results

Table 1

COVID Group	Group Count	DVT Count	p-value
Recent COVID-19	165		
- 1 month prior	(65)	3	
- 2 month prior	(35)	1	
- 3 month prior	(45)	1	
- 4 month prior	(20)	0	0.897
Current COVID-19	121	4	
Post-operative COVID-19	35	1	
No COVID-19	151	3	
Total Perioperative COVID-19	321	10 (3.12%)	0.463
No COVID-19	151	3 (1.99%)	

Table 1: 472 patients were included in the final data set. 321 patients had perioperative COVID-19 positive diagnosis, and 151 patients fell into the no COVID-19 group. Overall, the rate of symptomatic DVT among the cohort of patients who had foot or ankle surgery and had an associated COVID-19 diagnosis within the perioperative period was 3.12% (10/321). The rate among the no COVID-19 group was 1.99% (3/151). This difference was not statistically significant (p=0.463). When assessing the timing of COVID-19 diagnosis in relation to surgery (recent, current, post-operative, no COVID-19), there was no statistically significant difference in DVT incidence. Similarly, there was no difference when the recent COVID-19 diagnosis patients were subdivided into one-month increments. (Table 1).

Table 2

Variable	Group Count	DVT Count among COVID-19 Positive Group	p-value
Complete Vaccination	123	6	0.106
Partial Vaccination	10	1	
No vaccination	188	3	
Forefoot Surgery	170	7	0.257
Rearfoot/Ankle Surgery	151	3	
Trauma	116	4	0.764
Elective	205	6	

Table 2: There was no statistically significant difference in DVT rate between patients with COVID-19 undergoing foot and ankle surgery who were not vaccinated, partially vaccinated, or completely vaccinated. Similarly, there was also no increase DVT rate among patients who underwent forefoot surgery versus rearfoot surgery, or those who underwent operative intervention for traumatic injury versus elective surgery. (Table 3)

Table 3

Variable	Variable Count (Total Population)	No DVT Group	DVT Group	p-value	DVT Group and COVID-19 Positive	P-value
Gender	M: 218 F: 254	M: 209 F: 250	M: 9 F: 4	0.094		
Age (SD)	56.09 (15.80)	55.98 (15.86)	58.15 (14.11)	0.625		
BMI (SD)	31.94 (7.99)	31.90 (8.02)	32.42 (7.17)	0.819		
Previous DVT	50	Yes: 45 No: 414	Yes: 5 No: 8	0.0008*	Yes: 4 No: 6	1.000
History of Tobacco Use	201	Yes: 194 No: 265	Yes: 7 No: 6	0.402		
Venous Insufficiency	9	Yes: 9 No: 450	Yes: 0 No: 13	0.609		
Peripheral Vascular Disease	65	Yes: 61 No: 398	Yes: 4 No: 9	0.074		
Chronic Kidney Disease	68	Yes: 67 No: 392	Yes: 1 No: 12	0.489		
Coronary Artery Disease	99	Yes: 93 No: 366	Yes: 6 No: 7	0.025*	Yes: 5 No: 5	1.000
Diabetes Mellites	195	Yes: 188 No: 271	Yes: 7 No: 6	0.341		
Clotting Disorder	14	Yes: 13 No: 446	Yes: 1 No: 12	0.313		
Postoperative Chemical DVT Prophylaxis	309	Yes: 299 No: 160	Yes: 10 No: 3	0.127		

Table 3: All patient demographic factors and medical history were assessed in two groups: No DVT group and positive DVT group. Previous DVT and coronary artery disease led to a significant increase in the rate of DVT among our total patient population. However, when these variables were considered in the setting of a positive COVID-19 diagnosis verses those in the no COVID-19 group there was no statistically significant increase in the rate of DVT. Thus, the influence of COVID-19 did not lead to an increase in DVT among patients who had previous DVT or coronary artery disease. All other risk factors evaluated did not demonstrate a statistically significant influence on the rate of DVT.

Discussion

Numerous publications have suggested the DVT rate in foot and ankle surgery is relatively low in comparison to other larger orthopedic procedures[5]. Griffiths et al. reported a DVT rate of 0.42% following foot and ankle surgery[5]. In a large multicenter study, Mizel et al. reported a DVT rate of 0.22%[6]. The overall symptomatic DVT rate in our cohort of patients who had foot and ankle surgery with a perioperative COVID-19 diagnosis was 3.12%. This value was not statistically significant compared to our patient group without perioperative COVID-19 (1.99%).

Our data demonstrated there was no statistically significant difference regarding risk of symptomatic DVT in relation to a recent, current, post-operative, or no COVID-19 diagnosis There is limited research available on the incidence of DVT in patients with a recent COVID-19 diagnosis undergoing any surgical intervention. The evidence has been inconclusive in this regard with opposing results in the available studies assessing hip and knee arthroplasty and bariatric surgery[7,8,9].

Additionally, COVID-19 vaccination and its potential influence on DVT has come under scrutiny. Houghton et al. looked at 382,527 patients who had at least one COVID-19 vaccination and the overall rate of DVT was 1.86%[10]. There was no statistically significant difference in DVT rate between pre and post vaccination. Our study confirmed these findings, suggesting there is no difference in DVT rate based on COVID-19 vaccination status.

It is well understood that there is an increased risk for the development of DVT in trauma patients due to the long periods of venostasis, vascular insult, and periods of hypercoagulability[11]. Pitts et al. reviewing patients with ankle fractures and a COVID-19 diagnosis, found there was no statistically significant increase in DVT compared with a control group of patients with ankle fractures who were negative for COVID-19[12]. Our study supported those findings, with no statistical significance in DVT rate for patients with a positive COVID-19 diagnosis that underwent traumatic versus elective foot and ankle surgery.

Additionally, current literature also suggests there may be increased risk of DVT in hindfoot related procedures as compared to forefoot procedures[13]. However, in the setting of COVID-19, our study found no statistical significance when comparing the rate of DVT in those who underwent forefoot surgery compared to those who underwent hindfoot surgery.

Limitations of our study include the inherent risk of human error during chart review, possible DVTs diagnosed at outside institutions that would not have been accessible in the electronic medical record, and various sensitivities and specificities of COVID-19 testing that could have led to false positives or negative results.

Overall, none of the variables we assessed demonstrated an increased incidence of COVID-19 related DVT. The findings of this study suggest that perioperative COVID-19 does not increase the rate of DVT following foot and ankle surgery.

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