Factors Associated with Venous Thromboembolism Following Achilles Tendon Repair; a retrospective review

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INTRODUCTION: Rates of venous thromboembolism (VTE) after Achilles tendon rupture (ATR) are significantly higher than other foot and ankle conditions. Nonetheless, identifying patient-specific risk factors is challenging because the overall incidence is still lower than after hip or knee arthroplasty. Statistical analyses struggle to incorporate a large number of risk variables when the outcome being examined is too low. One method to overcome this is to utilize a matched analysis of patients, functionally enriching the cohort with patients who have had a VTE event after ATR and comparing them in a matched fashion to those who did not. This study aimed to compare the rate of VTE among patients with ATR and identify the correlation of patient-specific factors that are correlated with VTE incidence using a matched analysis.

METHODS: We conducted a retrospective case-control study using data from five hospitals within our healthcare system, including 202 patients who underwent surgical intervention for an ATR. Of these patients, 79 developed a confirmed VTE after tendon rupture - diagnosed via confirmed lower extremity ultrasound or PECT - within six months postoperatively. They were matched 1:1 by age and legal sex to 123 control ATR patients who did not experience VTE during the same period. Patients were categorized into case and control groups, respectively. Patient-specific variables were collected, and associations with VTE were assessed using Chi-square test for categorical variables and Pearson's correlation for continuous variables (Table 1). $P < 0.05$ was considered significant, and Bonferroni correction was applied where applicable.

RESULTS: The incidence of VTE was found to be higher in younger patients, patients with higher BMI, and those with a history of VTE ($P = 0.03$, $P < 0.01$, $P < 0.01$, respectively). Longer time to full weightbearing, low levels of physical activity, and presence of an infection were also clinical factors associated with an increased chance of developing VTE ($P < 0.01$, $P = 0.04$, $P < 0.01$, respectively). Interestingly, chemoprophylactic treatment, particularly with Factor Xa inhibitors, was found to also be associated with higher VTE rates ($P < 0.01$), not lower.

DISCUSSION AND CONCLUSION: While unmodifiable factors such as age, BMI, and a prior medical history of VTE were shown to play a significant role in developing VTE, there were also controllable post-operative clinical factors that were also correlated with VTE. Efforts to lower the risk of VTE include shortening the time to weightbearing, increasing the levels of physical activity in patients after ATR, and minimizing infection rates. The role of chemoprophylaxis is also a critical point of discussion, and this study underscores the challenge in retrospective analysis wherein patients at higher risk for VTE may selectively be more likely to get heparin analogues (rather than aspirin) confounding analysis of their protective effects. Further studies with larger and more diverse populations, and ideally prospective studies from multiple hospital systems, are needed to better understand these findings.

Table 1. Comparison of the demographic data between the case group comprised of patients who developed VTE after ATR and controls

	Cases (N = 79)	Controls (N = 123)	*P Value*
Age (years)	55.73 ± 13.99	57.58 ± 13.71	1.00*
Legal Sex (M/F)	79% / 21%	83% / 17%	1.00†
BMI	29.12 ± 5.04	27.51 ± 4.47	**< 0.01***
History of VTE (Yes/No)	16% / 83%	0% / 59%	**< 0.01†**
Type of Intervention (Open = 1 / MIS = 2)	88% / 12%	95% / 5%	0.95†
Prophylaxis (Yes/No)	78% / 22%	61% / 39%	**0.04†**
Short-Term (weeks)	11.84 ± 33.42	8.39 ± 12.97	0.65*
Long-Term (weeks)	4.08 ± 3.64	49.67 ± 78.31	0.05*
Total Duration (weeks)	14.01 ± 35.08	21.86 ± 85.04	0.35*
Aspirin (Yes/No)	48% / 52%	54% / 46%	0.33†
Heparin (Yes/No)	9% / 91%	4% / 96%	0.27†
Antifactor Xa (Yes/No)	18% / 82%	1% / 99%	**< 0.01†**
Warfarin (Yes/No)	5% / 94%	1% / 99%	0.07†
Other (Yes/No)	2% / 98%	1% / 99%	0.82†
Diabetes (Yes/No)	10% / 90%	7% / 93%	1.00†
CVD (Yes/No)	11% / 89%	10% / 90%	0.76†
CKD (Yes/No)	5% / 95%	5% / 95%	0.87†
Liver Disease (Yes/No)	3% / 97%	3% / 97%	0.96†
Level of Activity (Active = 1 / Bedbound = 0)	92% / 8%	100% / 0%	0.04†
Infection (Yes/No)	3% / 97%	0% / 0%	**< 0.01†**
Varicose Veins (Yes/No)	17% / 83%	20% / 80%	0.54†
Smoking Status (Active = 2, Past = 1, Never = 0)	2% / 21 % / 77%	3% / 17% / 80%	0.87†
Marijuana Use (Yes/No)	23% / 77%	14% / 86%	0.21†
Injury to Intervention (days)	35.74 ± 92.86	14.04 ± 31.01	0.44*
Number of Morbidities	0.87 ± 1.82	0.57 ± 1.79	0.55*
Degree of Hypercoagulability	0.15 ± 0.56	0.04 ± 0.43	**< 0.01***
ASA Score	1.70 ± 0.82	1.46 ± 0.64	0.08*
CCI	1.44 ± 1.96	1.61 ± 2.46	0.18*
10-year Survival Rate (%)	85.70 ± 24.63	84.81 ± 26.63	0.28*
Immobilization (weeks)	3.57 ± 2.27	2.99 ± 1.19	0.22*
Time to FWB (weeks)	16.56 ± 14.81	9.66 ± 2.49	**< 0.01***

Abbreviations: BMI, Body mass index; MIS, Minimally Invasive Surgery; CVD, Coronary Vascular Disease; CKD, Chronic Kidney Disease; ASA, American Society of Anesthesiologists; CCI, Charleston Comorbidity Index; FWB, full weight-bearing

* Independent T test, $P < 0.05$ was considered significant

† Chi Square test, $P < 0.05$ was considered significant