Clin Orthop Relat Res (2012) 470:270–274
DOI 10.1007/s11999-011-2166-6

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

CLINICAL RESEARCH

Incidence of Deep Vein Thrombosis and Pulmonary Embolism after Achilles Tendon Rupture

Arush Patel MD, Brent Ogawa MD, Timothy Charlton MD, David Thordarson MD

Received: 27 January 2011 / Accepted: 20 October 2011 / Published online: 2 November 2011

Abstract

Background The use of venous thromboembolism prophylaxis after an Achilles rupture is controversial. The rates of reported deep vein thrombosis (DVT) range from 6.3% to 34%. There is no agreement regarding prophylactic therapy after an Achilles tendon rupture.

Questions/purposes We determined the overall risk of DVT and pulmonary embolism (PE) after an Achilles tendon rupture and identified potential risk factors including surgery.

Patients and Methods We retrospectively reviewed a large healthcare management organization database and identified 1172 patients who had Achilles tendon ruptures. None of the patients routinely received anticoagulation. Patients were stratified into surgical versus nonsurgical group, age older than 40 years, history of congestive heart failure, previous history of DVT or PE, and BMI greater than 30. A patient was considered to have symptomatic DVT or PE related to the Achilles tendon rupture if diagnosed within 3 months from the injury or surgery. We used a multivariable analysis to identify risk factors.

Results The overall rates for DVT and PE after Achilles tendon ruptures were 0.43% and 0.34%, respectively. Age older than 40 years, congestive heart failure, history of DVT or PE, obesity, and whether a patient had surgery did not predict occurrence of DVT or PE.

Conclusion We found the overall incidence of symptomatic DVT and PE to be low after an Achilles tendon rupture and believe routine use of anticoagulation might be unwarranted.

Level of Evidence Level III, prognostic study. See the Guidelines for Authors for a complete description of levels of evidence.

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.
All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research* editors and board members are on file with the publication and can be viewed on request.
Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.
This study was performed at Kaiser Permanente, South Bay.

A. Patel, T. Charlton, D. Thordarson (✉)
Department of Orthopaedic Surgery, Keck School of Medicine, University of Southern California, 1520 San Pablo St Suite 2000, Los Angeles, CA 90033, USA
e-mail: thordars@usc.edu

B. Ogawa
Kaiser Permanente, South Bay, Harbor City, CA, USA

B. Ogawa
Department of Orthopaedic Surgery, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA

Introduction

Achilles tendon ruptures are common, with a reported incidence of 37.3 per 100,000 [9]. Treatment options include nonoperative treatment, immobilization, or surgery. A potential life-threatening complication is pulmonary embolism (PE). The incidences of deep vein thrombosis (DVT) and PE after THAs and TKAs have been studied extensively; however, data are sparse regarding the incidence of DVT or PE after an Achilles tendon rupture. A recent study of 208 patients with an injury to the Achilles tendon treated with cast immobilization reported a 6.3%

rate of symptomatic DVT and 1.4% rate of PE [6]. A study regarding routine screening for DVT using color duplex sonography after Achilles tendon ruptures reported a rate of 34% [19]. Although there is general consensus regarding the use of prophylactic antithrombotic therapy after hip and knee surgery [4], there is no agreement regarding prophylactic therapy after Achilles tendon rupture. Lapidus et al. [16] performed a randomized, placebo-controlled study of 91 patients with surgically treated Achilles tendon ruptures and found no beneficial effect of thromboprophylaxis with dalteparin in preventing DVT. The use of anticoagulation medications is not without side effects. Warfarin, a common anticoagulant, has been reported among the top 10 drugs with serious adverse events [25].

Lower limb immobilization after trauma is associated with DVT and PE [1, 14]. The increased risk of DVT can be attributed to many possible factors including trauma, immobilization, use of a tourniquet, or surgery [7, 8, 21]. Obesity (BMI $>$ 30) is reportedly a risk factor for DVT and PE after foot surgery [3]. In addition, one study found congestive heart failure (CHF) an independent risk factor for DVT [10].

Studies also are limited regarding whether surgical versus nonsurgical treatment of a ruptured Achilles tendon is associated with different rates of DVT and PE [19]. Nilsson-Helander et al. [19] reported, in a prospective randomized study of 100 subjects, no difference in the rate of DVT between surgical and nonsurgical treatments after an Achilles tendon rupture.

To clarify these issues, we asked: (1) what is the overall risk of having symptomatic DVT and PE develop after an Achilles tendon rupture; (2) whether surgical repair of an Achilles tendon rupture changes this risk; and (3) whether age (40 years or older), obesity (BMI $\geq$ 30), previous history of DVT or PE, and CHF increased the risk of DVT or PE after an Achilles tendon rupture.

Patients and Materials

We retrospectively identified all 1174 patients with partial and complete Achilles tendon ruptures treated at Kaiser Permanente (KP), Southern California, from January 2008 to March 2010. KP is a large nonprofit healthcare management organization (HMO). We searched the electronic medical records using specific ICD-9-Clinical Modification (CM) codes and Current Procedural Terminology (CPT) codes [11]. Patients with health insurance through KP receive all routine health care through this system, therefore even if they underwent treatment for PE elsewhere acutely, they would have received subsequent care in the Kaiser system. Two patients were excluded owing to polytrauma or surgery not related to the Achilles tendon. These two exclusions left 1172 patients. We stratified this group into surgical and nonsurgical groups, age older than 40 years, history of CHF, and BMI greater than 30. A total of 472 of 1172 (40%) patients underwent surgical treatment. The mean age of the patients was 45 years at the time of Achilles tendon rupture. Seven hundred twenty-five of 1155 (63%) patients with Achilles tendon ruptures were older than 40 years. Thirty of 1172 (2%) patients had CHF. Five hundred eighteen of 1150 (45%) were defined as obese (BMI of 30 or greater). No patients were lost to followup. No patients were recalled specifically for this study; all data were obtained from medical records. We had prior approval of the study protocol from the KP Institutional Review Board.

This patient population did not routinely receive anticoagulation, and none of the foot and ankle surgeons in the KP Southern California system who were surveyed routinely provided anticoagulation for patients with Achilles tendon ruptures.

Patients who presented with pain that would not be expected of an Achilles tendon rupture and signs and symptoms of DVT had diagnostic imaging. A patient was considered to have symptomatic DVT or PE related to the Achilles tendon rupture if diagnosed within 3 months from the injury or surgery. All patients with positive DVT and PE diagnoses had chart review to verify the diagnosis. Patients clinically diagnosed with DVT had a confirmatory duplex ultrasound. Patients with a suspected PE underwent CT with intravenous contrast or ventilation perfusion lung scan to confirm their diagnosis. We treated the nonsurgical group with plantar-flexed immobilization. None of the surgeons routinely obtained DVT screening for asymptomatic patients. Patients with polytrauma or who had surgery not related to the Achilles tendon were excluded.

All predictors were dichotomous with age cutoff at 40 years and BMI cutoff at 30. We compared the incidences of DVT and PE in Achilles tendon ruptures treated surgically versus nonsurgically using Fisher's exact chi-square test. The PE and DVT rates also were compared by age, BMI, history of PE and DVT, and CHF using chi-square analysis with $p < 0.05$ considered significant. A multivariate model was performed using logistic regression to test the combined effect of surgery, age, history of DVT and PE, and BMI on the incidences of DVT and PE.

Results

The overall rates of symptomatic DVT and PE after an Achilles tendon rupture were low, five of 1172 (0.43%) and four of 1172 (0.34%), respectively.

Table 1. Summary of incidence of DVT and PE with potential risk factors

Parameter	DVT	PE	p value
Surgical (472)	0.42% (2)	0.21% (1)	0.82
Nonsurgical (700)	0.43% (3)	0.43% (3)	
Age < 40 years (430)	0% (0)	0% (0)	0.068
Age ≥ 40 years (725)	0.69% (5)	0.55% (4)	
BMI < 30 (632)	0.16% (1)	0.32% (2)	0.285
BMI ≥ 30 (518)	0.77% (4)	0.39% (2)	
CHF (30)	0% (0)	3.33% (1)	0.016
NonCHF (1142)	0.44% (5)	0.26% (3)	
History of DVT (1)	100% (1)	0% (0)	0
No prior history of DVT (1171)	0.34% (4)	0.34% (4)	
History of PE (4)	0% (0)	0% (0)	0.985
No prior history of PE (1168)	0.43% (5)	0.34% (4)	

DVT = deep vein thrombosis; PE = pulmonary embolism.

Surgery did not predict an increased risk of DVT and PE (Table 1). We found a similar percentage of patients who had DVT or PE regardless whether they had surgery.

All documented DVTs and PEs in our overall population occurred in patients who were older than 40 years.

All predictors were dichotomous with age cutoff at 40 years and BMI cutoff at 30. None of the variables was significant ($p > 0.15$), and the model accounted for 0.8% of the variance in DVT and PE. Multivariate post hoc analysis showed a p value of 0.95, suggesting a low risk of a Type II error.

Discussion

A large range of rates of DVT are reported after Achilles tendon rupture, depending in part on the method of detection, and the use of venous thromboembolism prophylaxis is controversial. We therefore studied a relatively large patient population to determine (1) the overall rate of DVT and PE after Achilles tendon ruptures, (2) if surgical management changed this risk, and (3) potential risk factors, such as age older than 40 years, BMI, previous history of DVT and PE, or CHF.

We acknowledge limitations to our study. First, given its retrospective analysis we had no standard methods for detection of DVT or PE. Thus, we could have missed some patients who had either. However, since we had a controlled population and used the database of an HMO, we assume the number who had clinically meaningful DVT or PE which were missed would have been small. Second, there is a possibility of coding error. We think this unlikely because the diagnosis of the patients would be reviewed during followups. Third, there is a possibility that differences do exist with risk factors, and the study had insufficient power owing to low incidence rates.

The overall incidences of symptomatic PE and DVT were 0.43% and 0.34%, respectively. These rates were low and are consistent with rates reported in similar studies of injuries to the lower extremity (Table 2). SooHoo et al. [23], in a hospital discharge database study, examined the incidence of PE in more than 52,000 ankle fractures and reported an overall rate of 0.34%. A large retrospective analysis of greater than 7000 patients after podiatric surgery reported an incidence of 0.30% for postprocedural venous thromboembolic disease [3]. Mizel et al. [18], in a prospective multicenter study, reported incidences of DVT of 0.22% and nonfatal PE of 0.15% after foot and ankle surgery. Wukich and Waters [24], in a retrospective study of 1000 patients after foot and ankle surgery, reported incidences of 0.4% for DVT and 0.3% for nonfatal PE. One weakness of all these studies was that none used a HMO database and might have lost patients to followup to other practitioners after the complication occurred. In this HMO patient population, even if the patient had a PE or DVT treated at a nonHMO facility, they would have reentered the HMO system and the DVT or PE would have been added to the patient's record. Other studies have reported higher rates of DVT and PE (Table 2). Nilsson-Helander et al. [19] reported a 34% rate of DVT after routine scans using color duplex sonography. Patients with Achilles tendon ruptures treated with cast immobilization had a 6% rate of symptomatic DVT and/or PE [6]. Our reported incidence of symptomatic DVT is lower than incidences reported in other studies. We are uncertain of the cause for this discrepancy but it might be because all of our patients with or without surgery were mobilized with crutches after the rupture.

We found no difference in the rates of DVT and PE between surgically and nonsurgically treated Achilles tendon ruptures. There also were no differences in the incidences of DVT and PE after Achilles tendon ruptures regarding obesity, age older than 40 years, history of DVT or PE, or CHF. However, all patients with DVT and PE were older than 40 years. Aging, which often is associated with obesity and decline in muscle strength, might lead to functional and metabolic changes. These changes might predispose a patient to DVT or PE [2]. CHF, history of DVT or PE, and obesity might be risk factors, but perhaps we did not have an adequate number of patients to show this difference.

None of the four of our patients with PE had a documented DVT. This may be attributable to the lack of DVT studies being ordered once the PE had been confirmed, one patient with confirmed PE had a negative duplex. The absence of confirmatory laboratory studies for patients with

Table 2. Summary of studies of lower extremity injuries and surgeries with incidences of DVT and PE

Study	Type of study	Number of patients	Injury type	DVT rate	PE rate	Venous thromboembolic disease	Study specifics
Current study	Retrospective	1172	Achilles tendon	0.43%	0.34%		Symptomatic patients
Lassen et al. [17]	Prospective	188	Leg fracture or ruptured Achilles tendon	19%	1.1%		All patients routinely screened for DVT
SooHoo et al. [23]	Retrospective	57,183	Ankle fractures	0.05%	0.34%		Readmission database
Felcher et al. [3]	Retrospective	7000	Foot and ankle surgery			0.30%	
Mizel et al. [18]	Prospective	2733	Foot and ankle surgery	0.22%	0.15%		
Wukich & Waters [24]	Retrospective	1000	Foot and ankle	0.4%	0.3%		
Patil et al. [20]	Prospective	100	Nonoperative ankle fractures	5% (0% symptomatic)	0%		Routinely screened for DVT
Solis & Saxby [22]	Prospective	201	Foot and ankle surgery	3.5%			All patients routinely screened for DVT; no proximal DVT
Hanslow et al. [5]	Retrospective	602	Foot and ankle surgery			4%	
Lapidus et al. [15]	Prospective	136	Ankle fracture surgery	28% (3% proximal)			Routinely screened for DVT
Kock et al. [13]	Prospective	163	Cast immobilization	4.3%			
Jorgensen et al. [12]	Prospective	106	Leg immobilization	17%			Routinely screened for DVT

DVT = deep vein thrombosis; PE pulmonary embolism.

PE might have decreased the reported incidence of DVT in our study, however, assuming every patient with a PE had an undiagnosed DVT would still bring the incidence of DVT to only 0.77%.

Overall, these findings are useful in counseling patients regarding the risks and benefits of routine anticoagulation after an Achilles tendon rupture. Based on these findings, it is our recommendation that prophylactic anticoagulation not be routinely administered.

Acknowledgments We thank Christianne Joy Lane PhD (Biostatistician, University of Southern California) for assistance with the statistical analysis**.** Her participation in this publication was supported by NIH/NCRR SC-CTSI Grant Number UL1 RR031986. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH.

References

1. Bergqvist D, Lowe G. Venous thromboembolism in patients undergoing laparoscopic and arthroscopic surgery and in leg casts. *Arch Intern Med*. 2002;162:2173–2176.
2. Di Nisio M, Di Iorio A, Porreca E, Abate M, Ferrante N, Bandinelli S, Guralnik J, Molino-Lova R, Cuccurullo F, Ferrucci L. Obesity, poor muscle strength, and venous thromboembolism in older persons: the InCHIANTI Study. *J Gerontol A Biol Sci Med Sci.* 2011;66:320–325.
3. Felcher AH, Mularski RA, Mosen DM, Kimes TM, DeLoughery TG, Laxson SE. Incidence and risk factors for venous thromboembolic disease in podiatric surgery. *Chest*. 2009;135:917–922.
4. Geerts WG, Bergqvist D, Pineo GF, Heit JA, Samama CM, Lassen MR, Colwell CW; American College of Chest Physicians Evidence-Based Clinical Practic. Chest. 2008;133(6 suppl):381S–453S.
5. Hanslow SS, Grujic L, Slater HK, Chen D. Thromboembolic disease after foot and ankle surgery. *Foot Ankle Int.* 2006;27:693–695.
6. Healy B, Beasley R, Weatherall M. Venous thromboembolism following prolonged cast immobilisation for injury to the tendo Achilles. *J Bone Joint Surg Br*. 2010;92:646–650.
7. Heit, JA, Silverstein MD, Mohr DN, Petterson TM, O'Fallon WM, Melton LJ 3rd. Risk factors for deep vein thrombosis and pulmonary embolism: a population-based case-control study. *Arch Intern Med*. 2000;160:809–815.
8. Hofmann AA, Wyatt RB. Fatal pulmonary embolism following tourniquet inflation: a case report. *J Bone Joint Surg Am.* 1985; 67:633–634.
9. Houshian S, Tscherning T, Riegels-Nielsen P. The epidemiology of Achilles tendon rupture in a Danish county. *Injury*. 1998;29: 651–654.
10. Howell MD, Geraci JM, Knowlton AA. Congestive heart failure and outpatient risk of venous thromboembolism: a retrospective, case-control study. *J Clin Epidemiol.* 2001;54:810–816.
11. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM). Available at: http://www.cdc.gov/nchs/icd/icd9cm.htm. Accessed October 5, 2011.
12. Jorgensen PS, Warming T, Hansen K, Paltved C, Vibeke Berg H, Jensen R, Kirchhoff-Jensen R, Kjaer L, Kerbouche N, Leth-Espensen P, Narvestad E, Rasmussen SW, Sloth C, Tørholm C, Wille-Jørgensen P. Low molecular weight heparin (Innohep) as thromboprophylaxis in outpatients with a plaster cast: a venografic [sic] controlled study. *Thromb Res*. 2002;105:477–480.
13. Kock HJ, Schmit-Neuerburg KP, Hanke J, Rudofsky G, Hirche H. Thromboprophylaxis with low-molecular-weight heparin in outpatients with plaster-cast immobilisation of the leg. *Lancet.* 1995;346:459–461.
14. Kujath P, Spannagel U, Habscheid W. Incidence and prophylaxis of deep venous thrombosis in outpatients with injury of the lower limb. *Haemostasis.* 1993;23(suppl 1):20–26.
15. Lapidus LJ, Ponzer S, Elvin A, Levander C, Larfars G, Rosfors S, de Bri E. Prolonged thromboprophylaxis with Dalteparin during immobilization after ankle fracture surgery. *Acta Orthop*. 2007; 78:528–535.
16. Lapidus LJ, Rosfors S, Ponzer S, Levander C, Elvin A, Larfars G, de Bri E. Prolonged thromboprophylaxis with dalteparin after surgical treatment of achilles tendon rupture: a randomized, placebo-controlled study. *J Orthop Trauma*. 2007;21:52–57.
17. Lassen MR, Borris LC, Nakov RL. Use of the low-molecular-weight heparin repivarin to prevent deep vein thrombosis after leg injury requiring immobilization. *N Engl J Med*. 2002;347: 726–730.
18. Mizel MS, Temple HT, Michelson JD, Alvarez RG, Clanton TO, Frey CC, Gegenheimer AP, Hurwitz SR, Lutter LD, Mankey MG, Mann RA, Miller RA, Richardson EG, Schon LC, Thompson FM, Yodlowski ML. Thromboembolism after foot and ankle surgery: a multicenter study. *Clin Orthop Relat Res.* 1998;348:180–185.
19. Nilsson-Helander K, Thurin A, Karlsson J, Erisson BI. High incidence of deep venous thrombosis after Achilles tendon rupture: a prospective study. *Knee Surg Sports Traumatol Arthrosc.* 2009;17:1234–1238.
20. Patil S, Gandhi J, Curzon I, Hui ACW. Incidence of deep vein thrombosis in patients with fractures of the ankle treated in a plaster cast. *J Bone Joint Surg Br*. 2007;89:1340–1343.
21. Samama MM. An epidemiologic study of risk factors for deep vein thrombosis in medical outpatients: the Sirius study. *Arch Intern Med*. 2000;160:3415–3420.
22. Solis G, Saxby T. Incidence of DVT following surgery of the foot and ankle. *Foot Ankle Int.* 2002;23:411–414.
23. SooHoo NF, Krenek L, Eagan MJ, Gurbani B, Ko CY, Zingmond DS. Complication rates following open reduction and internal fixation of ankle fractures. *J Bone Joint Surg Am*. 2009;91:1042–1049.
24. Wukich DK, Waters DH. Thromboembolism following foot and ankle surgery: a case series and literature review. *J Foot Ankle Surg*. 2008;47:243–249.
25. Wysowski DK, Nourjah P, Swartz L. Bleeding complications with warfarin use: a prevalent adverse effect resulting in regulatory action. *Arch Intern Med*. 2007;167:1414–1419.