

# Thromboembolism After Foot and Ankle Surgery

## A Multicenter Study

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**Thromboembolic disease presents a potentially fatal complication to patients undergoing orthopaedic surgery. Although the incidence after hip and knee surgery has been studied**

**and documented, its incidence after surgery of the foot and ankle is unknown. For this reason, a prospective multicenter study was undertaken to identify patients with clinically evident thromboembolic disease to evaluate potential risk factors. Two thousand seven hundred thirty-three patients were evaluated for preoperative risk factors and postoperative thromboembolic events. There were six clinically significant thromboembolic events, including four nonfatal pulmonary emboli, after foot and ankle surgery. The incidence of deep vein thrombosis was six of 2733 (0.22%) and that of nonfatal pulmonary emboli was four of 2733 (0.15%). Factors found to correlate with an increased incidence of deep vein thrombosis were nonweightbearing status and immobilization after surgery. On the basis of these results, routine prophylaxis for thromboembolic disease after foot and ankle surgery probably is not warranted.**

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Thromboembolic disease is a potentially fatal but relatively common complication after total hip surgery; the incidence of deep vein thrombosis ranges from 35% to 60%, with pulmonary embolus occurring in as many as 16% of patients. Fatal pulmonary emboli have been reported to occur in as many as 3.4% of patients after total hip surgery with

no prophylactic anticoagulation.<sup>3,4,6,7,13,16,18,19</sup> To decrease the incidence of thromboembolic disease, multiple postoperative regimens have been used, including sodium warfarin, dextran, low molecular weight heparin, aspirin, heparin, low dose adjusted heparin, and compression boots. These modalities have been variably successful in reducing the incidence of this disease.<sup>5,10,17,21</sup>

Some authors<sup>8</sup> have attributed the high incidence of deep vein thrombosis in orthopaedic surgery to the operations being performed on the lower limb. However, the incidence of deep vein thrombosis or clinically detectable thromboembolic disease after foot and ankle surgery is unknown. Thus, a multicenter prospective study was undertaken to ascertain the incidence of and to assess potential causative risk factors associated with thromboembolic disease after foot and ankle surgery.

## MATERIALS AND METHODS

Each of 15 orthopaedic surgeons from major institutions across the country completed a one page questionnaire (Table 1) on every surgical episode involving the foot and ankle from January 1, 1995, through December 31, 1995. Patients with multiple traumatic injuries were excluded. Parameters recorded included age, gender, height, weight, and type of procedure. Also included were associated medical conditions, concurrent medications, history of thromboembolic disease, intraoperative tourniquet use, postoperative immobilization, and postoperative weightbearing status. Patients were observed for clinically detectable thromboembolic disease. Radiologic testing for deep vein thrombosis or pulmonary embolus was performed as considered clinically appropriate by the treating physician. The use of postoperative prophylaxis, if any, for each patient was determined by the treating surgeon. No attempt to influence thromboembolism prophylaxis or detection was made as a condition of study participation.

For the purposes of this study, the forefoot was defined as the anatomic structures from the proximal metatarsals to the distal phalanx; the midfoot from the proximal metatarsals to Chopart's joint;

TABLE 1. Study Parameters

Demographics
Age
Height
Weight
Gender
Associated medical conditions
Cancer
Diabetes
Hypertension
Cardiac disease
Previous deep venous thrombosis
Previous pulmonary embolism
Hepatitis
Osteoarthritis
Rheumatoid arthritis
Seronegative arthropathies
Medications
Nonsteroidal antiinflammatories
Sodium warfarin
Steroids
Insulin
Oral hypoglycemics
Birth control pills
Surgery
Procedure
Tourniquet use
Tourniquet site
Postoperative
Weightbearing status
Immobilization
Calf or thigh swelling
Calf tenderness
Homans' sign
Thrombosis testing performed
Anticoagulation
Other complications

the hindfoot as the talus and calcaneus; and the ankle included the talocrural joint and distal leg. Pantalar and tibiocalcaneal arthrodeses were considered hindfoot procedures, as were tarsal tunnel releases. All categorical data were evaluated using nonparametric chi squared testing. Analysis of variance was performed as was considered appropriate. For the purpose of analysis,  $p < 0.05$  was considered statistically significant.

## RESULTS

The study population consisted of 2733 patients who met the inclusion criteria. Six patients were excluded because of incomplete

data sheets; none of these had a thromboembolic event. The average age of the 1027 (37.6%) male patients and 1706 (62.4%) female patients was 47.6 years, with a standard deviation of 16.77 years (range, 5-90 years). Of the 2733 procedures, 1365 (50%) were in the forefoot, 233 (8.5%) were in the midfoot, 493 (18%) were in the hindfoot, and 590 (21.6%) were in the ankle. The location of surgery was unknown in 52 (1.9%) patients. Postoperative followup averaged 91 days (range, 0-144 days).

Six patients experienced clinically detectable deep vein thromboses. Each was confirmed by ultrasound or venogram. Four of these thrombi were in the calf and two were in the thigh. Four of these caused nonfatal pulmonary emboli. Both of the thigh thrombi were associated with pulmonary emboli. The total incidence of thromboembolic disease was six of 2733 (0.22%). The total incidence of pulmonary emboli was four of 2733 (0.15%). All pulmonary emboli were confirmed by ventilation and perfusion studies. Of the 2504 (92%) patients who received no postoperative anticoagulation (no information was available for 10 patients), the rate of thromboembolic disease was four of 2504 (0.16%). The rate of thromboembolism was two of 218 or 0.92% for those who received postoperative anticoagulation. The onset of clinically detectable symptoms was 34.8 days after surgery (range, 3-70 days).

Eighteen (0.7%) patients had a history of a deep vein thrombosis (including two patients who had pulmonary emboli develop previously) and seven (0.3%) other patients had previous pulmonary emboli, for a total of 23 patients with a previous thromboembolic event. Of these patients, only one had a thromboembolic event in this study, a pulmonary embolus.

There were two deaths in this series. Both were consequences of chronic, longstanding illnesses, with no suspicion of thromboembolic disease in either patient.

No relationship was found between the occurrence of thromboembolic disease and age,

weight, diabetes mellitus, history of previous deep vein thrombosis, cancer, cardiac disease, hypertension, or any medical condition. There also was no association between thromboembolic disease and osteoarthritis, rheumatoid arthritis, systemic lupus erythematosus, or steroid use. Tourniquet use was not predictive of a thromboembolic event, nor was the site of the tourniquet (ankle, calf, or thigh). The duration of tourniquet use also was not found to be a risk factor (Tables 2, 3). There was no correlation with concurrently obtaining iliac crest bone graft. There was no statistical difference between arthrodeses and open reduction and internal fixation of fractures or between predominantly soft tissue procedures and predominantly bony procedures.

The only variables found to correlate with an increased incidence of thromboembolic disease were postoperative nonweightbearing and immobilization (Table 4). All patients with thrombotic events had been treated postoperatively with immobilization and nonweightbearing, with an incidence of thromboembolism of six of 1150 (0.52%). The increased relative risks of deep vein thrombosis for these two treatment regimens were 1.004 (95% confidence interval, 1.0008 to 1.007;  $p = 0.033$ ) and 1.004 (95% confidence interval, 1.0009 to 1.008;  $p = 0.014$ ), respectively.

## DISCUSSION

The diagnosis of deep vein thrombosis by physical examination is difficult and often equivocal.<sup>8</sup> In the current study, each surgeon followed his or her own regimen regarding prophylactic measures to prevent thromboembolic disease. Any patient with a clinical presentation of deep vein thrombosis was evaluated and treated as the treating surgeon judged appropriate. Although other studies of total hip replacement have used invasive tests on all postoperative patients,<sup>1,15,20</sup> it was thought not appropriate to perform such tests in this study because no information exists regarding the incidence or

TABLE 2. Associated Medical Conditions and Medications

	Number Present	% Present
Medical conditions		
Any	996	36.5
Hypertension	572	21.0
Diabetes	274	10.0
Rheumatoid arthritis	169	6.2
Osteoarthritis	141	5.2
Cancer	26	1.0
Thromboembolic disease	25	1.0
Hepatitis	14	0.5
Systemic lupus erythematosus	7	0.3
Medications		
Nonsteroidals	330	12.1
Insulin	177	6.5
Steroids	129	4.7
Aspirin	63	2.3
Sodium warfarin	19	0.7

severity of thromboembolic disease after foot and ankle surgery.

The question addressed by this study is whether patients should receive thromboembolic prophylaxis after foot and ankle surgery. To attempt to answer this, it must be appreciated that the basal rate of thromboembolic disease in the general population has been reported to be 0.076% (0.085% in males, 0.068% in females).<sup>11</sup> In a study of 1174 total hip replacements performed between 1962 and 1973 without thromboembolic prophylaxis, Johnson et al<sup>9</sup> found 26 (2.3%) fatal pulmonary emboli and 179 nonfatal pulmonary emboli (diagnosed by chest radiographs and electrocardiograms), for a total prevalence of 17.5%. Using venograms after total knee replacement, Stulberg et al<sup>20</sup> found that 84% of patients with no thromboembolic prophylaxis had ipsilateral deep vein thrombosis develop. Of those who received prophylaxis, venograms revealed a 10.7% incidence of ipsilateral deep vein thrombosis in the popliteal veins or thigh and a 1.1% incidence in the popliteal vein of the contralateral limb. With such a high prevalence of this potentially fatal problem, prophylactic measures to attempt to prevent pulmonary emboli generally have been accepted by the orthopaedic community.

In the current study, there was no association of clinically detectable thrombi with age, gender, height, weight, location of surgery, associated medical conditions (Table 2), or concurrent medications. History of thromboembolic disease did not appear to increase the risk factor, and neither did intra-operative tourniquet use (Table 3). The only statistically significant relationships with thromboembolic events were postoperative regimens of nonweightbearing and cast immobilization.

In the current study the only factors that were found to correlate with thromboembolism were postoperative nonweightbearing and immobilization (Table 4), each of which increased the relative risk by 0.04%. Because all of the patients in the study who were nonweightbearing also were immobilized, the two effects could not be separated from each other, although the increased rate is consistent with the findings of Micheli.<sup>12</sup> A patient with these risk factors had an approximately 0.04 times greater risk than the 0.22% rate of thromboembolic events for the entire cohort, increasing the incidence from 0.2195% to 0.2204%. In an attempt to differentiate between the incidence of thromboembolic disease secondary to traumatic events

TABLE 3. Tourniquet Use in Surgeries

Site and Duration	Number	%
Overall	1939	72.2
Tourniquet site		
Thigh	1035	53.4
Calf	250	12.9
Ankle	639	33.0
Toe	15	0.8
Duration (hours) of tourniquet use		
<0.5	614	31.7
0.5-1.0	665	34.3
1.0-1.5	371	19.1
1.5-2.0	182	9.4
>2.0	51	2.6
Unknown	56	2.9

and that secondary to nontraumatic events, the authors compared the incidence of thromboembolic events after arthrodeses with that after open reduction and internal fixation of fractures; there was no clinically significant difference. In a similar fashion, procedures that involved primarily soft tissue were compared with those that involved primarily bone, and no statistically significant difference was found in terms of thromboembolic events. On the basis of the data from the current study, the potential risk of a thromboembolic event in patients having foot and ankle surgery is considerably lower than that for patients undergoing total joint replacement of the hip or knee. The frequency of fatal pulmonary embolus after foot and ankle surgery could not be deter-

mined by this study, but it appears to be less than one of 2733 (0.037%).

To justify routine prophylaxis in this low risk surgical population, an economic analysis of the costs incurred is necessary. Noninvasive surveillance of patients after surgery for possible deep vein thrombosis can be accomplished by ultrasound examination. The cost for one examination at The Johns Hopkins Hospital is \$420 (including technical and professional fees). Routine screening to detect deep vein thrombosis would have cost \$191,520 to find each clinically significant deep vein thrombosis in the current study. Because there were no fatal pulmonary emboli in this study, the cost of surveillance to find and prevent a fatal pulmonary embolus would have been an uncertain amount in excess of \$1,147,860.

Routine prophylaxis costs include medication and monitoring expenses. Ten prothrombin measurements would be needed during a 6-week postoperative course (cost, \$137). At an average, the cost of warfarin would be approximately \$28 for a 6-week treatment period, so the total cost would be \$165 per patient or \$450,945 for all of the 2733 patients, excluding the cost of treatment of any potential complications.

Low dose adjusted warfarin, designed to keep the prothrombin level at approximately 1.5 times the normal level, has been found to decrease the incidence of thromboembolic disease. However, a 0.57% to 0.75% incidence of nonfatal pulmonary emboli re-

TABLE 4. Influence of Postoperative Treatment on Thromboembolism Prevalence

Postoperative Treatment	Thromboembolism		
	No	Yes	P
Nonweightbearing			
No	1363	0	
Yes	1324	6	0.014
Immobilization			
No	1256	0	
Yes	1438	6	0.033

mains.<sup>215</sup> Complications remain with this, including an increased incidence of severe postoperative bleeding (1.5% to 4%),<sup>214</sup> and guaiac positive stools, hematuria, epistaxis, skin ecchymosis, hypermenorrhea, and hemoptysis. If the entire cohort had received this anticoagulation, between 41 (1.5%) and 109 (4%) complications could have been expected. Given the low incidence of deep vein thrombosis after foot and ankle surgery and the costs and potential complications involved, the authors of this study think that the risks and costs of thromboembolic prophylaxis and screening are not justified for the small gain that may accrue.

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