The incidence of thromboembolic disease in foot and ankle surgery is not well characterized. A prospective study by Mizel et al surveyed 15 orthopedic surgeons and found a 0.22% incidence of deep vein thromboses (DVT) and 0.15% incidence of nonfatal pulmonary emboli in 2253 patients over 1 year. Routine screening was not performed, and clinical suspicion was the impetus for obtaining studies. No fatal pulmonary embolisms were reported. This survey suggests that thromboembolic prophylaxis is used by <50% of surgeons treating foot and ankle trauma. The reported cases of thromboembolism in this study underline the need for a prospective investigation.

This study hypothesized that thromboembolism in patients with foot and ankle trauma is higher than currently recognized, and that prophylaxis varies among surgeons. A questionnaire sent to members of two orthopedic specialty societies surveyed the use of thromboembolic prophylaxis over 1 year. Most did not use preoperative prophylaxis. Postoperatively, 44% of surgeons used prophylaxis, most commonly sequential compression devices and low molecular weight heparin. This survey suggests that thromboembolic prophylaxis is used by <50% of surgeons treating foot and ankle trauma. The reported cases of thromboembolism in this study underline the need for a prospective investigation.

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Trauma patients are at higher risk for thrombotic events due to increased hypercoagulability and decreased function of the fibrinolytic system. Increased hypercoagulability results from stasis from required immobilization, direct endothelial damage to the vessels, and specific alterations in the clotting mechanism including increased tissue factor release. Clinical studies of trauma patients have corroborated this physiological data, showing increased incidence of DVT and pulmonary embolism in patients with single extremity and multiple extremity trauma. Furthermore, these patients are frequently immobilized for prolonged periods before surgery, which also places them at higher risk than the general population of elective surgical patients.

This study focused on a specific subpopulation of foot and ankle patients who we believed to be at an increased risk: those who sustained an acute traumatic injury and are evaluated, immobilized, and released for delayed definitive management. The soft tissues of the foot and ankle are often severely affected by trauma, and many surgeons currently delay surgery until swelling decreases to avoid skin slough and infection. Due to health care economics, convenience, or planned transfer of care to a different surgeon, many patients, who in the past would have been admitted for elevation and observation, are instead provisionally treated and released with surgery scheduled at a later time. Although patients admitted to the hospital are frequently given prophylaxis against DVT, those who are discharged for later follow-up are usually not treated. This study examined the attitudes of surgeons treating foot and ankle injuries with regard to thromboembolic prophylaxis.

**MATERIALS AND METHODS**

A one page survey consisting of 9

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The authors thank Douglas S. Wolf for assisting with the database design, and Steven Reinert for statistical assistance.

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### DVT Prophylaxis in Elective Foot and Ankle Surgery

1. How many **ELECTIVE FOOT AND/OR ANKLE TRAUMA** cases did you perform between January 1, 2000 and December 31, 2000 (ex: Achilles rupture, Lisfranc injury, calcaneal or ankle fracture, etc...evaluated as an acute trauma, then sent home and brought back at a later date for operation)?

   - <5
   - 5-10
   - 11-20
   - 21-30
   - 31-40
   - 41-50
   - 51-75
   - 76-100

   a. Do you routinely splint all these patients before surgery? __YES__ __NO

   b. How many of the patients in Question #1 developed a: Symptomatic DVT? __Symptomatic PE? __

2. Do you use PRE-operative DVT prophylaxis in the outpatient setting during the interim before elective surgery for these foot/ankle trauma patients? __Always__ __Sometimes__ __Never

   a. If always, what do you use? (check all that apply, AND circle the ONE agent used most commonly)

      - Aspirin__ __SC heparin
      - LMW heparin__ __Warfarin__ __External Foot and Leg Pumps__ __Compressive Stockings
      - Subcutaneous low molecular weight heparin (eg, Lovenox, Fragmin)
      - Foot intrinsics exercises
      - High dose aspirin (eg, 325 mg bid)
      - Low dose aspirin (ex, 80 mg qd)
      - Foot pumps
      - Early mobilization (when?)

   b. If sometimes, is this only in patients with risk factors? __YES__ __NO

   c. When do you screen them? __Postoperative day 2__ __Postoperative day 3__ __1 week__ __2 weeks__ __3 weeks__ __4 weeks__ __5 weeks__ __6 weeks__ __>6 weeks__

   b. How do you screen them? __Ultrasound__ __Venography__ __Other__ __

3. Do you routinely use INTRA-operative DVT prophylaxis in these same patients? __YES__ __NO

   If YES, what type? __Foot pumps__ __Leg pumps__ __Compressive stockings__ __Intra-operative heparin__ __Immediate preoperative warfarin or heparin__ __Other: __

4. Do you routinely use POST-operative DVT prophylaxis in these patients? __YES__ __NO (if yes, check all used. AND circle the ONE agent used most commonly)

   - Compressive stockings__ __Sequential compression devices (Leg pumps)__ __Warfarin__ __Subcutaneous heparin__ __Compressive Stockings__ __Subcutaneous low molecular weight heparin (eg, Lovenox, Fragmin)__ __Foot intrinsics exercises__ __Intra-operative heparin__ __Other: __

   a. If YES, how long do you treat patients with DVT prophylaxis?

      - __1 week__ __2 weeks__ __3 weeks__ __4 weeks__ __5 weeks__ __6 weeks__ __>6 weeks__

   b. If NO, are there certain circumstances in which you do? __YES__ __NO

   c. What risk factors would lead you to place a patient on post-operative DVT prophylaxis? __

   d. What agent would you use? __

5. Do you routinely treat foot/ankle trauma patients who are immediately admitted and kept in the hospital for upcoming surgery? (as opposed to those patients in Question #1 with DVT prophylaxis) __YES__ __NO

   a. If YES, do you treat them __always__ __only if they have risk factors (please list: ________________________________)

   b. What agent would you use? __

6. Do you screen for DVT in any of the elective foot/ankle trauma patients in Question #1 after surgery? __YES__ __NO

   a. If YES, which ones? __All__ __Only those with risk factors__ __

   b. How do you screen them? __Ultrasound__ __Venography__ __Other: __

   c. When do you screen them? __Postoperative day 2__ __Postoperative day 3__ __1 week__ __>1 week__ __Before discharge__

7. Prophylaxis against DVT in elective foot and ankle trauma patients is: __Mandatory__ __Sometimes needed__ __Waste of time__

8. How many foot and ankle surgical cases did you perform last year? __

   How many of THESE patients developed a: __asymptomatic DVT (ie, pre-screened)__ __symptomatic DVT (post-confirmed by studies)__ __Symptomatic nonfatal PE__ __Fatal PE__

9. Your Practice Location (State/Province, and Country): __

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**Figure:** Survey sent to 1400 orthopedic surgeons regarding DVT prophylaxis for foot and ankle trauma. Abbreviations: DVT=deep vein thrombosis, LMW=low molecular weight, PE=pulmonary embolism, and SC=subcutaneous.

Questions was mailed to 1400 surgeons—947 active and candidate members of the American Orthopaedic Foot and Ankle Society and 453 active and candidate members of the Orthopaedic Trauma Association (Figure). The questionnaire was reviewed and sanctioned by each society prior to mailing. Members with emeritus, international, honorary, or resident status were excluded. A stamped return envelope was provided for ease of response, and participation was voluntary and anonymous.

Responses were tabulated at 6 weeks, after which no further returned questionnaires were accepted for this study. A custom-designed Microsoft Access database (Microsoft, Redmond, Wash) was used to organize the data. Using Stata statistical software (Stata Corp, College Station, Tex), the data were tabulated and analyzed.

**RESULTS**

At 6 weeks, 508 responses from 1400 questionnaires mailed were received, a response rate of 36%. Five hundred surgeons reported their location; 489 were from the United States. Eight were from

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Canada, and 1 each from England and Switzerland. One orthopedic surgeon working in a locum tenens position also responded.

Questionnaires were accepted if part of each of the nine questions was answered; thus, the total denominator of responses for each question varied. A wide range of case numbers was reported for foot and ankle trauma patients who were evaluated acutely (eg, in an emergency department) and sent home for subsequent scheduled surgery (Table 1). The majority of surgeons (90%) stated they splinted these patients before surgery, with exceptions reported for calcaneal fractures and Achilles tendon ruptures.

The questionnaire surveyed surgeons about the use of pre-, intra-, and postoperative thromboembolic prophylaxis in this patient population. Sixty-seven percent of surgeons never used preoperative prophylaxis, with 29% reporting occasional use (Table 2). For those surgeons who occasionally used thrombosis prophylaxis, the most common risk factor influencing this decision was a history of DVT or pulmonary embolism. Only 4% always used preoperative protective measures against DVT. The most commonly reported agents used were external foot pumps, aspirin, and low molecular weight heparin. Other modalities were compression stockings, warfarin, and subcutaneous heparin.

Most surgeons did not use any form of intraoperative prophylaxis (Table 2). For the 15% minority who used prophylaxis, most used compression stockings (52%) followed by foot pumps and leg pumps. A few surgeons reported using warfarin or heparin intraoperatively or immediately prior to surgery.

Forty-four percent of surgeons stated that they used some form of postoperative DVT prophylaxis, and most indicated multiple interventions. The most common modalities for postoperative prophylaxis included sequential compression devices (41%), low molecular weight heparin, and early mobilization (Table 3). The length of prophylaxis use varied; one third of surgeons reported use for ≤1 week (Table 4).

Routine postoperative prophylaxis was not used by >50% of respondents. However, certain risk factors led a majority of this group to use thrombosis protection. The most common risk factors included history of DVT or pulmonary embolism, multitrauma, and obesity. Surgeons reported the use of warfarin, low molecular weight heparin, and aspirin as prophylaxis most commonly.

Most surgeons surveyed (88%) did not screen for DVT in the foot and ankle trauma population. Of those who reported using screening, it was most commonly done for patients with risk factors. Ultrasound was the preferred imaging modality, with some surgeons using physical examination for screening. No surgeon listed venography or any other diagnostic study.

When asked about a different subset of patients with foot and ankle trauma, those immediately admitted to the hospital pending surgical treatment, surgeons were more likely to use thromboembolic prophylaxis.
In this population, 59% of surgeons use prophylaxis, with an even split between treating only patients with risk factors and treating all patients. Risk factors quoted were similar to the outpatient surgery population, with the most common being a history of a thrombotic event and multi-trauma. Again, low molecular weight heparin, aspirin, and warfarin were the most commonly used agents.

Surgeons were then queried for their general opinion of DVT prophylaxis and its necessity in elective scheduled foot and ankle trauma patients. Seventy percent believed that prophylaxis was sometimes needed. Few surgeons believed that some form of prophylaxis was mandatory, with 25% stating that prophylaxis was unnecessary.

Finally, surgeons were asked to list the total number of foot and ankle surgeries they had performed during the year surveyed. The median number was 100, with a mean of 170 (range: 0-1300 surgeries). The total for all surgeons was 86,175 cases. Respondents were then asked to report how many DVT and pulmonary embolism episodes occurred in their patients. Surgeons reported 43 asymptomatic and 376 symptomatic DVT episodes over 1 year. Sixty-four fatal pulmonary embolism events were reported in their patients. Surgeons went on to a pulmonary embolus. This study provides further evidence of the thromboembolic risk posed by lower extremity fractures and prolonged immobilization.

The foot and ankle literature on the occurrence of DVT or pulmonary embolism comprises mostly case reports. Mizel et al surveyed 15 surgeons who reported the 1-year incidence of thromboembolic disease by filling out a questionnaire on each surgical patient, with a 0.22% rate of DVT and a 0.15% rate of pulmonary embolism. In that study, patients with multiple trauma were specifically excluded, screening for venous thromboses or pulmonary emboli was based on clinical factors, and the use or nonuse of prophylaxis was not controlled or recorded.

Solis and Saxby studied 201 patients undergoing foot and ankle surgery with routine screening ultrasound at the first postoperative follow-up. Trauma patients were not specifically evaluated in this study. Ultrasound was performed for screening at the popliteal vein and distally; thus, no proximal thromboses were detectable or reported, which may have underestimated results. No patients were treated with thromboembolic prophylaxis. This study showed a 3.5% (7/201) incidence of DVT. Hindfoot surgery, immobi-
lization combined with hindfoot surgery, increased tourniquet time, and increased age were significantly correlated with an increased incidence of DVT.

A recent study detailed three cases of pulmonary embolism following operative fixation of ankle fractures in which no anti-pulmonary embolism following operative age were significantly correlated with an increased tourniquet time, and increased mobilization combined with hindfoot surgery. The authors concluded that thromboembolic prophylaxis should be considered in lower extremity surgery in patients presenting with risk factors for thrombosis.

In the current study, we focused on electively operated foot and ankle trauma patients, a subpopulation that has not previously been studied regarding thromboembolic disease risk. This anonymous and voluntary cross-sectional survey was performed to gather information on the practices of surgeons who care for this subgroup of patients. In this survey, surgeons were asked about their practice in the year 2000. Approximately 44% of surgeons used some form of prophylaxis against DVT postoperatively, whereas few surgeons used pre- or intra-operative prophylaxis. Of those surgeons using postoperative prophylaxis, 33% used it for ≤1 week. The most common types of prophylaxis reported were sequential compression devices, low molecular weight heparin, and early mobilization. Ninety percent of surgeons did not screen routinely for DVT, and those who did screen used ultrasound almost exclusively.

The weaknesses of this questionnaire-based survey include limited demographic and risk information on the thromboembolic events reported, its voluntary nature (which is open to selection bias and incomplete questionnaire results), and a lack of discrete numbers of cases against which to compare reported events. It is also subject to the recollection bias of a retrospective evaluation. The study was designed, however, to assess surgeons’ attitudes about DVT prophylaxis to determine whether a more in-depth analysis would be useful.

This study is valuable because of its cross-sectional nature with input from a large number of surgeons. Additionally, this survey shows a wide variability in thromboembolic prophylaxis, particularly post-operatively. Science does not dictate what surgeons are doing regarding thromboembolic prophylaxis in the foot and ankle trauma population. The reported thromboembolic events in this surgeon survey indicate that DVT and pulmonary embolism occur in foot and ankle surgery cases and underline the need for a prospective analysis of this issue.

REFERENCES