

# Deep vein thrombosis associated with lower extremity amputation

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**Purpose:** Patients undergoing lower extremity amputation are perceived to be at high risk for deep vein thrombosis (DVT). Limited data are available, however, to confirm this impression. The purpose of this study is to prospectively document the incidence of DVT complicating lower extremity amputation.

**Methods:** During a recent 28-month period, 72 patients (71 men, 1 woman; mean age 68 years) undergoing major lower extremity amputation (31 above-knee and 41 below-knee) were prospectively evaluated with perioperative duplex scanning for DVT.

**Results:** DVT was documented in nine (12.5%) patients (one bilateral, four ipsilateral, and four contralateral to amputation). Patients with a history of venous disease were at significantly higher risk for development of DVT ( $p = 0.02$ ). Thrombi were located at or proximal to the popliteal vein in eight patients and were isolated to the tibial veins in one patient. DVT was identified before operation in six patients and after operation in three. Patients with DVT were treated with heparin anticoagulation, with no patient experiencing clinical symptoms compatible with pulmonary embolism.

**Conclusions:** In our recent experience, lower extremity amputation is associated with DVT at or proximal to the popliteal vein in 11% of patients. Documentation of DVT prevalence is essential to assist surgeons in planning a management strategy for prevention, diagnosis, and treatment of DVT associated with lower extremity amputation. (J VASC SURG 1995;22:612-5.)

Virchow<sup>1</sup> related venous thrombosis to the clinical triad of hypercoagulability, venous stasis, and vascular injury. The patient undergoing lower extremity amputation is potentially at high risk for thromboembolic complications. Immobility and surgically induced venous endothelial trauma may predispose the patient undergoing amputation to development of lower extremity deep vein thrombosis (DVT). In addition, as many as 25% to 30% of patients undergoing vascular surgery may have an associated hypercoagulable condition.<sup>2</sup>

In spite of the perception that lower extremity amputation is associated with thromboembolic complications, limited data are available documenting the prevalence of DVT after amputation. Two small studies have reported conflicting results with the

prevalence of DVT ranging from 0% to 67% after lower extremity amputation.<sup>3,4</sup> The purpose of our study was to prospectively ascertain the prevalence of DVT among a large cohort of patients undergoing vascular surgery and lower extremity amputation.

## PATIENTS AND METHODS

From September 1992 through December 1994 at our Veterans Affairs Medical Center, patients undergoing major lower extremity amputation (above- or below-knee) underwent screening for lower extremity DVT by use of duplex scanning. Patients were assessed for potential risk factors for DVT including age, diabetes, kidney failure, preexisting venous disease, history of malignancy, prior amputation or lower extremity surgery, and extensive pedal infection. Duplex examinations were performed before (within 3 days of amputation) and after operation (before discharge.) Patients did not routinely receive anticoagulants for DVT prophylaxis. Intravenous heparin was administered before and after operation to patients on long-term warfarin therapy. In addition, patients who were discovered to have DVT either before or after operation were given intrave-

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nous heparin in the perioperative period and subsequently switched to long-term warfarin therapy.

Venous duplex examinations were performed in a standard fashion by use of a color-flow duplex scanner (Acuson 128; Acuson Corporation, Mountain View, Calif.). Criteria for a positive examination result included abnormal venous Doppler flow signals and visualized evidence of intraluminal thrombi confirmed by inability to coapt the vein walls with application of gentle pressure by the transducer.<sup>5</sup>

**Statistical analysis.** Analysis of preoperative factors in patients with DVT compared with patients without DVT was performed with an exact chi-square test. A significant difference was assumed with  $p < 0.05$ .

## RESULTS

During the study period 72 patients (71 men, 1 woman; mean age 68 years) underwent lower extremity amputation. Indications for amputation included acute ischemia with irreversible muscle, nerve, and cutaneous damage ( $n = 18, 25\%$ ), extensive ulceration or osteomyelitis and soft tissue infection ( $n = 30, 42\%$ ), and chronic ischemia in infirm, bedridden patients ( $n = 24, 33\%$ ). Initially, there were 31 above-knee and 41 below-knee procedures. Ten patients required a second amputation (six conversions from guillotine to conventional below-knee, three amputation revisions, and one amputation of the contralateral extremity) for a total of 82 amputations in 72 patients.

Preoperative risk factors are shown in Table I. The operative mortality rate was 4%, with deaths ( $n = 3$ ) caused by pneumonia, kidney failure, and myocardial infarction. Twelve patients did not undergo screening before operation with duplex studies because of the requirement for emergency amputation. Two patients did not undergo screening after operation because of early postoperative death.

Nine (12.5%) of 72 patients were found to have DVT. Four of 31 (13%) patients undergoing above-knee amputation and 5 of 41 (12%) patients undergoing below-knee amputation were found to have DVT. Risk factors that may predispose to venous thrombosis among the patients with and without perioperative DVT are shown in Table II. Patients with a history of venous disease (DVT or chronic venous insufficiency) were at higher risk for perioperative DVT ( $p = 0.02$ ). There was a similar trend for patients with preexisting lower extremity amputation ( $p = 0.08$ ). DVT involvement was contralateral to the side of extremity amputation in four patients, bilateral in one, and ipsilateral to the

**Table I.** Prevalence of operative risk factors before amputation ( $n = 72$ )

Mean age (yrs.)	68
Hypertension	37 (51%)
Coronary symptoms	44 (61%)
Diabetes	42 (58%)
Renal impairment	16 (22%)

amputation in four patients. Thrombi were located at or proximal to the popliteal vein in eight patients and were isolated to infrapopliteal veins in one patient. DVT was identified before operation in six patients. Three patients were diagnosed early after operation. Two of the three patients with postoperative DVT had normal preoperative duplex examination results, and the remaining patient did not undergo preoperative screening.

Among patients without DVT, 14% (9 of 63) were receiving warfarin before operation. Indications for warfarin included atrial fibrillation, prosthetic heart valve, lower extremity bypass, or a history of recurrent DVTs. These patients received perioperative heparin anticoagulation. All patients with DVT were treated with heparin anticoagulation. One patient had preoperative lower extremity swelling and was clinically suspected of having venous thrombosis that was subsequently confirmed by duplex scanning. No patient experienced symptoms compatible with pulmonary embolism.

## DISCUSSION

Multiple risk factors may predispose patients undergoing amputation to thromboembolic complications. From 25% to 30% of patients undergoing vascular surgery have an identifiable hypercoagulable condition.<sup>2</sup> In addition, many patients requiring lower extremity amputation are elderly, sedentary individuals with longstanding arterial disease who in many cases have undergone previous amputation (21% in this series).<sup>6</sup> In our series, patients with a history of venous disease and those with preexisting amputation appeared to be at the highest risk for development of DVT. Additional clinical features often found in patients requiring lower extremity amputation and that may predispose to venous thrombosis include diabetes, sepsis, and malignancy.<sup>7</sup>

Previous authors have, with conflicting results, evaluated the association between major lower extremity amputation and venous thrombosis. Harper et al.<sup>3</sup> used contrast venography of the ipsilateral iliofemoral segment and found DVT in 15 (67%) patients after above-knee amputation. Barnes and

Table II. Prevalence of potential DVT risk factors

	Patients with DVT (n = 9)	Patients without DVT (n = 63)
Age (mean $\pm$ SD) (yrs.)	69 $\pm$ 8	68 $\pm$ 12
Diabetes (%)	7 (78%)	35 (56%)
Preexisting venous disease (%)*	3 (33%)	3 (5%)
Malignancy history (%)	0 (0%)	8 (13%)
Prior amputation (%)†	4 (44%)	11 (17%)
Prior lower extremity vascular surgery	5 (56%)	33 (52%)
Dialysis dependent (%)	1 (11%)	8 (12.6%)
Extensive ulceration or infection (%)	5 (56%)	25 (40%)

\**p* = 0.02.†*p* = 0.08.

Slymaker,<sup>4</sup> however, prospectively examined 35 patients undergoing 42 lower extremity amputations (28 below-knee, 14 above-knee) with continuous-wave Doppler examinations and were unable to detect a single case of DVT, although one patient had a pulmonary embolus. We found no difference in the prevalence of DVT among our patients undergoing above-knee (4 of 31, 13%) compared with below-knee amputation (5 of 41, 12%).

Duplex scanning is currently the most widely used noninvasive confirmatory test for symptomatic DVT. The accuracy of duplex scanning for detecting proximal DVT is well established. Sensitivity exceeds 90%, and specificity approaches 100%.<sup>8</sup> Surprisingly, no prospective studies with duplex scanning used to document the prevalence of DVT associated with lower extremity amputation have been published, although Kerr et al.<sup>9</sup> have presented data identifying DVT in 17% of 24 patients undergoing amputation prospectively evaluated with perioperative duplex scanning. Their results closely approximate our findings and support the conclusion that DVT is often associated with lower extremity amputation. The potential association may be even greater than suggested by this report in that 14% of our patients were receiving heparin anticoagulation, and the remainder were on antiplatelet therapy.<sup>10</sup>

It is noteworthy that five of our nine patients with DVT undergoing amputation had involvement of the contralateral extremity. DVT screening in this patient population should therefore include duplex examinations of both lower extremities.<sup>11</sup> All contralateral DVT were potentially clinically important with thrombi located at or cephalad to the popliteal vein in four of the five cases. Patients with ipsilateral DVT undergoing amputation are at risk for stump swelling and delayed healing of the amputation. It may also be difficult to fit these patients with a prosthesis.<sup>12,13</sup> One of our patients with ipsilateral

DVT had development of stump swelling and infection that required amputation revision.

All but three of our DVT cases were diagnosed before operation. It may be that the debilitated sedentary status of most patients undergoing amputation is the most important factor in the development of their DVT. The operative procedure itself may play only a minor role in the pathogenesis of DVT associated with lower extremity amputation. However, the procoagulant tendency induced by the operation, superimposed on additional venous endothelial trauma, may predispose to propagation of venous thrombus and pulmonary embolism.<sup>14,15</sup>

In our experience, 12.5% of patients were found to have perioperative DVT at the time of lower extremity amputation, with those with a history of chronic venous disease or preexisting amputation at highest risk. Generally, the surgeon has three management options regarding DVT associated with amputation, including a primary prophylaxis strategy with pneumatic compression used on the opposite leg or anticoagulation, an intensive monitoring program with routine Doppler ultrasonography or duplex scanning, or a more conservative approach focused on investigating only patients who have development of symptoms consistent with DVT or pulmonary embolism.<sup>8,16,17</sup> It is not the purpose of this report to argue in favor of a single management approach. Our results may be useful, however, for surgeons interested in formulating a management strategy.

On the basis of the preceding natural history data, our management approach currently focuses on preoperative duplex scanning of patients undergoing amputation. DVT prophylaxis, other than aspirin therapy, is not routinely administered.<sup>10</sup> DVT detected before operation is treated with heparin anticoagulation for 5 to 7 days to allow for clot stabilization before elective amputation. The efficacy

of this approach will require confirmation by additional prospective analysis.

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