

? **Clinical question:** Does ambulation immediately following an episode of deep vein thrombosis increase the risk of pulmonary embolism?

A 68-year-old woman who had no known musculoskeletal or neuromuscular impairments fell in her home and sustained a fracture of the left femoral neck. The fracture was treated surgically by replacement of the femoral head and neck (hemiarthroplasty), and the patient began physical therapy in her hospital room the day after surgery. The initial physical therapy interventions included exercises to increase range of motion of the hip and to increase force of the quadriceps femoris and hip abductor muscles. In preparation for ambulation, standing and weight-shifting activities also were instituted at the bedside on the day after surgery. On the second day after surgery, I saw the patient in the physical therapy department, where she began ambulation using parallel bars, with weight bearing to tolerance on the left lower extremity. By the third postoperative day, she was ambulating with a walker for distances of up to 12 meters (40 feet). She did not need any support or assistance, but I provided instruction occasionally to ensure proper technique and safety.

The patient continued to progress well until she developed sharp pain in her left calf. Subsequent testing using Doppler ultrasound revealed a deep vein thrombosis (DVT). Following surgery, the patient had been receiving a prophylactic dose of the antithrombotic medication enoxaparin (Lovenox) (30 mg administered subcutaneously every 12 hours). When she developed the DVT, the dose of enoxaparin was increased according to her body weight (75 kg) so that she was receiving an antithrombotic treatment dose of 75 mg every 12 hours (ie, 1 mg of enoxaparin per kg of body weight administered subcutaneously every 12 hours). The patient also was supposed to be wearing lower-extremity compression stockings after surgery, but she had apparently been removing the stockings from time to time because they were uncomfortable. She therefore was informed about proper use of these stockings and was advised to wear them continuously.

As the physical therapist in charge of this case, I was encouraged by the patient's physician to resume ambulation activities "as soon as possible." I was concerned, however, that ambulation by a patient with acute DVT may increase the risk of pulmonary embolism (PE). I decided to search the literature to find out whether ambulation is safe immediately following an episode of DVT.

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This month, Physical Therapy introduces a new feature designed to show how evidence is gathered and used to guide clinical decision making. Patient examples illustrate this process.

The screenshot shows the PubMed search interface. At the top, there are logos for NCBI, PubMed, and the National Library of Medicine (NLM). Below the logos, there are navigation tabs for PubMed, Nucleotide, Protein, Genome, Structure, Pop Set, Taxonomy, and OMIM. The search bar contains the query "deep vein thrombosis AND ambulation". Below the search bar, there are buttons for "Go" and "Clear". There are also links for "Limits", "Preview/Index", "History", "Clipboard", and "Details". The "Limits" option is selected, and the search results are displayed as a list of three articles. The first article is by Davis JD, and the second and third are by Manganaro A, Buda D, Ando G, Consolo F. The interface also shows a "Query box" and a "Link to abstract" button.

PubMed Search Screen With Search Results Displayed. Reproduced with permission of the National Library of Medicine.

■ **Database used for search:** MEDLINE

MEDLINE is the National Library of Medicine’s premier computerized bibliographic database covering the fields of medicine, nursing, and health and rehabilitation sciences, including physical therapy. I selected this database because I wanted to access literature from medical journals as well as journals dealing specifically with physical rehabilitation. Access to MEDLINE is free to the public, and I accessed MEDLINE’s online version, PubMed, via the Internet at www.ncbi.nlm.nih.gov/PubMed. This search was performed on October 1, 2001.

■ **Initial keywords:** deep vein thrombosis and ambulation

I started the search with 2 keywords: **deep vein thrombosis** and **ambulation**. Although I was tempted to use the acronym “DVT,” I decided to spell out the full term. The full term appeared to be a better way to retrieve all the relevant articles in this database. I might miss important articles by using only the acronym.

I also had to consider another potential problem. Often, slightly different terms are used to describe the same condition; in this case, for instance, I also could have used **deep venous thrombosis**. I decided to use the term **deep vein thrombosis** because it appears to be the more commonly used term and because a follow-up search using **deep venous thrombosis** did not yield any additional relevant articles. I typed the following—**deep vein thrombosis AND ambulation**—in PubMed’s query box at the top of the screen. (In PubMed, operators such as “AND” or “OR” must be fully capitalized in order to conduct the search properly.)

The initial result was 76 articles, or “hits.” Although the number of hits was large, it did not seem so large that alternate or additional keywords were needed at this point. To narrow the number of hits, I decided instead to place some “limits” on the type of article. Clicking on the **Limits** option on the Features bar under the query box allowed me to restrict the type of article according to various criteria.

■ **Limits:** 5 years; human

After clicking on the **Limits** option, I selected “Entrez Date,” which allowed me to restrict this search to articles that were entered into the database after a certain date (eg, within the last 30 days, 60 days, 1 year). I selected **5 years** because of recent advances in the medical and pharmacological treatment of DVT, especially the use of low molecular weight heparins (LMWHs) such as enoxaparin. The use of LMWHs as a primary treatment for DVT has evolved over the past few years, and evidence of when ambulation is safe following DVT should take into account contemporary anticoagulant therapy. The other limit, **human**, restricted the search to articles that dealt with studies on people rather than animals.

Imposing these limits reduced the number of hits from 76 to 19 articles. I decided to glance at the titles of a few of these articles to find out whether I was on the right track. A cursory look suggested that most of these articles dealt with some aspect of deep vein thrombosis, and that certain articles dealt specifically with resuming activity after an episode of DVT. It appeared that I was on the right track, and the total number of articles (19) did not seem overwhelming. Rather than impose further limits or use additional keywords, I began examining each article. The citations from these articles are listed in the box on the next page.

Citations Retrieved by Search Using the Keywords "Deep Vein Thrombosis" and "Ambulation"

1: Davis JD.

Prevention, diagnosis, and treatment of venous thromboembolic complications of gynecologic surgery. *Am J Obstet Gynecol.* 2001 Mar;184(4):759-75. Review.

2: Manganaro A, Buda D, Ando G, Consolo F.

[Compression therapy in deep venous thrombosis]. *Minerva Cardioangiol.* 2000 Dec;48(12 Suppl 1):57-60. Italian.

3: Manganaro A, Buda D, Calabro D, Tati' L, Consolo F.

[Physical treatment of deep venous thrombosis: bed rest or mobilization]? *Minerva Cardioangiol.* 2000 Dec;48(12 Suppl 1):53-6. Italian.

4: Manganaro A, Giannino D, Lembo D, Bruni F, Consolo F.

[Evolution in the pharmacological treatment of venous thrombosis according to evidence-based medicine]. *Minerva Cardioangiol.* 2000 Dec;48(12 Suppl 1):41-51. Review. Italian.

5: Aschwanden M, Labs KH, Engel H, Schwob A, Jeanneret C, Mueller-Brand J, Jaeger KA.

Acute deep vein thrombosis: early mobilization does not increase the frequency of pulmonary embolism. *Thromb Haemost.* 2001 Jan;85(1):42-6.

6: Blattler W, Kreis N, Blattler IK.

Practicability and quality of outpatient management of acute deep venous thrombosis. *J Vasc Surg.* 2000 Nov;32(5):855-60.

7: Shammas NW.

Pulmonary embolus after coronary artery bypass surgery: a review of the literature. *Clin Cardiol.* 2000 Sep;23(9):637-44. Review.

8: Church V.

Staying on guard for DVT & PE. *Nursing.* 2000 Feb;30(2):34-42; quiz 43-4. No abstract available.

9: Burke DT.

Prevention of deep venous thrombosis: overview of available therapy options for rehabilitation patients. *Am J Phys Med Rehabil.* 2000 Sep-Oct;79(5 Suppl):S3-8. Review.

10: Stiefelhagen P.

[Thrombosis ABC, 4: Leg and pelvic vein thrombosis. Compression stockings on the leg and out of bed]? *MMW Fortschr Med.* 1999 Sep 30;141(39):46. German. No abstract available.

11: Partsch H.

[Ambulatory management of thrombophlebitis]. *Vasa.* 2000 Feb;29(1):3-4. German. No abstract available.

12: Westrich GH, Farrell C, Bono JV, Ranawat CS, Salvati EA, Sculco TP.

The incidence of venous thromboembolism after total hip arthroplasty: a specific hypotensive epidural anesthesia protocol. *J Arthroplasty.* 1999 Jun;14(4):456-63.

13: Mertl P, Jarde O, Van FT, Doutrelot P, Vives P.

[Percutaneous tenorrhaphy for Achilles tendon rupture. Study of 29 cases]. *Rev Chir Orthop Reparatrice Appar Mot.* 1999 Jun;85(3):277-85. French.

14: Blattler W.

[Aspects of cost effectiveness in therapy of acute leg/pelvic vein thrombosis]. *Wien Med Wochenschr.* 1999;149(2-4):61-5. Review. German.

15: Partsch H.

["Ambulatory" therapy of deep venous thrombosis of the leg—definition]. *Wien Med Wochenschr.* 1999;149(2-4):28-9. German.

16: Al-Wakeel JS, Milwalli AH, Malik GH, Huraib S, Al-Mohaya S, Abu-Aisha H, Memon N.

Dual-lumen femoral vein catheterization as vascular access for hemodialysis—a prospective study. *Angiology.* 1998 Jul;49(7):557-62.

17: Kibel AS, Creager MA, Goldhaber SZ, Richie JP, Loughlin KR.

Late venous thromboembolic disease after radical prostatectomy: effect of risk factors, warfarin and early discharge. *J Urol.* 1997 Dec;158(6):2211-5.

18: Kiser TS, Stefans VA.

Pulmonary embolism in rehabilitation patients: relation to time before return to physical therapy after diagnosis of deep vein thrombosis. *Arch Phys Med Rehabil.* 1997 Sep;78(9):942-5.

19: Innes GD, Dillon EC, Holmes A.

Low-molecular-weight heparin in the emergency department treatment of venous thromboembolism. *J Emerg Med.* 1997 Jul-Aug;15(4):563-6.

■ **Selection of Articles for Review:** I read each title to get a sense of each article's relevance. I did not consider articles that dealt with prevention of DVT, because I was looking for studies that determined when it might be safe to resume ambulation *after* an episode of DVT. Likewise, I ignored review articles at this point because I wanted to see whether any studies provided primary (original) data that indicate when ambulation might be safe. Three articles seemed appropriate, and the PubMed abstracts of these articles are reproduced and discussed briefly here.

Manganaro A, Buda D, Calabro D, Tati' L, Consolo F. [Physical treatment of deep venous thrombosis: bed rest or mobilization]? [Article in Italian] *Minerva Cardioangiol* 2000 Dec;48(12Suppl 1):53-56. Scuola di Specializzazione in Cardiologia Malattie dell'Apparato Cardiovascolare Cattedra di Angiologia, Università degli Studi, Messina.

The need of prolonged bed-rest for the treatment of Deep Venous Thrombosis (DVT), which was considered essential to control the thrombotic phenomenon and to prevent Pulmonary Embolism (PE) until ten years ago, has now been critically reviewed in the light of the great success of the Low Molecular Weight Heparin (LMWH) in medical therapy of DVT. There is a great evidence for bed-rest and immobility to play a pivotal role in the growth and in the progression of a venous thrombosis. The Authors emphasize, both on the international reports and their own experience, that, in most cases, medical treatment of DVT consists of an outpatient—ambulatory care based on immediate mobilization and ambulation, on external compression therapy, on early LMWH administration and late oral anticoagulation. This regimen provides great benefits in order to prevent PE, to improve the quality of life, to reduce the hospital and the anticoagulant monitoring charges.

Although this article was written in Italian, I decided to look at the English version of the abstract (by clicking on the authors' names). This abstract suggested that this paper is a clinical perspective rather than a research article. Nonetheless, the abstract supported my theory that use of LMWHs may promote earlier mobilization and ambulation of people with DVT. This abstract also implied that ambulation combined with external compression (presumably in the form of compression stockings) can begin immediately after a DVT episode and that early ambulation may actually prevent PE and other detrimental changes associated with prolonged bed rest. Given that this paper was published in an Italian journal, any additional information from this paper would be difficult to obtain, so I decided to find out whether the other 2 articles that I had identified might be helpful.

Aschwanden M, Labs KH, Engel H, Schwob A, Jeanerret C, Mueller-Brand J, Jaeger KA. Acute deep vein thrombosis: early mobilization does not increase the frequency of pulmonary embolism. *Thromb Haemost* 2001 Jan;85(1):42-46. Department of Angiology, University of Basel Medical School, University Hospitals Basel, Switzerland.

Outpatient treatment for acute symptomatic deep vein thrombosis (DVT) was shown to be safe for most patients. However, little is known whether patients treated on an outpatient basis were ambulating or predominantly resting, a factor which may be decisive for the outcome. In the present study 129 DVT patients were randomized to either strict immobilization for 4 days or to ambulate for $>$ or $=$ 4 hours per day under supervision in order to show, whether the old concept of temporary immobilization is superior to early mobilization or not. The DVT diagnosis was based on duplex sonography; all patients were screened for PE at baseline and at day 4 by pulmonary ventilation-perfusion scanning, and were followed up for a total of 3 months. Clinically, changes in leg circumferences and leg pain were evaluated. The frequency of PE at baseline was 53.0% and 44.9% in the immobile and the mobile groups, respectively. During the 4 days observation period new PEs were found in 10.0% and in 14.4% of the immobilized and the ambulating patients (delta 4.4%; 95% CI -0.5 to 13.8; $\chi^2 = 0.596$, $p = 0.44$). The occurrence of new PE was related to the presence of PE at baseline but not to other potential predictors. The magnitude of a decrease in leg circumferences and leg pain was comparable in both groups. No patient died during the 4 day observation period. The total 3 month mortality rate was 3.9% (5 patients; 2 from the immobile, 3 from the ambulating group). All 5 patient suffered from malignancies. The results of this study show in accordance with the trial hypothesis that, regarding the frequency of PE, immobilization is not superior to early mobilization, suggesting that early mobilization is safe. Publication Types: Clinical trial Randomized controlled trial

This randomized controlled trial suggested that patients who ambulated immediately following an episode of DVT did not have an increased risk of PE compared with patients who were confined to 4 days of bed rest. To learn more about the details of this study, I reviewed the full-text article at a nearby medical library. The article did not indicate whether physical therapy was provided to these patients, but patients in the ambulation group were supervised by nurses who encouraged the patient to walk around the hospital ward for at least 4 hours each day during the 4-day trial. This article provided only limited information about the medical history of these patients, so it was not clear how many patients were being treated for orthopedic conditions such

as hip replacement. The site of DVT was likewise restricted to proximal venous (popliteal, femoral, or iliac veins) segments in these patients. The average age of the patients was 65 years, so at least these subjects were similar in age to the patient that I was managing. However, approximately half the patients in each group already had a PE at the beginning of this study. Sixteen new cases of PE were also diagnosed at the end of the 4-day trial, with 6 patients in the bed-rest group and 10 patients in the ambulation group developing PE over the 4 days.

Although there was no difference in the overall incidence of PE between these groups, I was concerned about the rather high incidence of PE in this study population (much more than 50% in each group). I therefore was reluctant to accept the idea that immediate ambulation is completely safe based solely on the information in this study.



Kiser TS, Stefans VA. Pulmonary embolism in rehabilitation patients: relation to time before return to physical therapy after diagnosis of deep vein thrombosis. *Arch Phys Med Rehabil* 1997 Sep;78(9):942-945. Department of Physical Medicine and Rehabilitation, University of Arkansas for Medical Sciences, Little Rock, USA.

OBJECTIVE: There is increased risk of a pulmonary embolism (PE) after a deep vein thrombosis (DVT). The effect of mobilizing the affected lower extremity has not been well studied. The purpose of this study was to detect any change in the rate of PE occurrence dependent on time to mobilization in patients diagnosed with a DVT in a rehabilitation hospital. **DESIGN:** Retrospective case-control study. **SETTING:** Urban rehabilitation hospital. **PATIENTS:** Data were collected from charts of 190 patients with a discharge diagnosis of PE or DVT at an urban rehabilitation hospital from January 1991 to June 1995; 127 patients met inclusion criteria in the study. **INTERVENTIONS:** Measurement of time to return to physical therapy after diagnosis of DVT. **MAIN OUTCOME MEASURES:** A DVT was diagnosed with either Doppler ultrasound or venogram testing, a PE by ventilation/perfusion (V/Q) scan, and time to mobilization in hours until return to physical therapy. **RESULTS:** One hundred twenty-one patients had a DVT without a subsequent PE and a mean time of 123.2 hours until mobilization. Six patients had a subsequent PE and a mean time of 48.3 hours until mobilization ($p = .021$). A Fischer exact test comparing patients with and without PE who were returned to therapy before 48 hours and after 48 hours ($p = .018$), and before and after 72 hours ($p = .059$), supports the hypothesis that patients who return to physical therapy earlier are more likely to develop a PE than patients who return later. **CONCLUSIONS:** It is imperative to prophylactically treat all patients at risk of a DVT with anticoagulation if possible. Once a DVT is diagnosed it is prudent to keep the affected limb immobilized for at least 48 to 72 hours while the patient is being anticoagulated. A large prospective cohort study is needed to answer the question of when to mobilize a patient after diagnosis of a DVT.

This retrospective study reviewed charts from a large number of patients and identified a total of 127 patients with DVT. These patients had a mean age of 66 years (range=16-95 years) and had various diagnoses, including stroke (31%), hip fracture (13%), spinal cord injury (11%), and other medical diagnoses. The patients with DVT who did not sustain a subsequent PE ($n=121$) generally resumed physical therapy much later (an average of 123 hours after DVT) compared with a much smaller group of patients ($n=6$) who sustained a PE after resuming physical therapy an average of 48 hours after the DVT.

It would be tempting to assume that early physical therapy activities increased the risk of PE following a DVT. This assumption, however, must be tempered by the fact that this was a retrospective study. That is, these patients were *not* randomly divided into groups that returned to physical therapy at specific times (eg, immediately, after 48 hours, after 72 hours, and so forth) and then studied prospectively to determine the incidence of PE in each group. Nonetheless, additional statistical analysis suggested that a higher incidence of PE did occur in the group of patients who resumed physical therapy earlier (within 48 hours), and that the risk of PE was not increased in patients who were withheld from physical therapy for 72 hours or longer.

■ **Clinical Decision:** Based on the study by Kiser and Stefans, I decided to withhold ambulation activities for this patient for at least 48 hours following the episode of DVT. Although the evidence from this study is limited because of its retrospective design and the unbalanced patient subgroups (only 6 patients out of 127 sustained a PE), I felt that this study provided a preliminary benchmark for when ambulation should be resumed. Evidence from other studies (see Aschwanden et al) suggested that immediate ambulation did not increase the risk of PE as compared with bed rest, but I found the high incidence of PE in both subject groups in the Aschwanden et al study disturbing. A 48-hour hiatus from ambulation activities seemed prudent and consistent with the findings of Kiser and Stefans. Barring any further coagulation problems, ambulation activities could be resumed between 48 and 72 hours if the patient was not in any untoward distress (ie, the DVT is not extremely painful or bothersome). After 72 hours, ambulation should be progressively increased according to patient tolerance.

I documented my plan of care in the patient's medical chart, and this documentation was used to notify the physician and nursing staff of this plan. I did not consult directly with the physician because the patient was generally in good health and a modest delay in resuming ambulation would probably not have had severe detrimental effects on this patient's overall functional ability. If this patient had been more severely debilitated (that is, debilitated to the extent that a 48-hour delay might cause a substantial decline in cardiovascular and neuromuscular function), I would have contacted the physician to discuss whether the benefit of resuming ambulation sooner (eg, within 48 hours) might outweigh the risk of developing a PE.