Ambulation and Compression After Deep Vein Thrombosis: Dispelling Myths

Hugo Partsch, MD

The traditional dogma of putting mobile patients with acute deep vein thrombosis into bed for several days has been challenged by some studies that showed a better clinical outcome with walking exercises under good compression. Repeated lung scans did not show an increased risk of new pulmonary embolism. There was a faster and more intense reduction of pain and swelling and a clear quality-of-life benefit. Immediate ambulation with compression reduces the propagation of thrombi and has a positive impact regarding development of postthrombotic syndrome. Patients selected for home therapy should not only be instructed how to inject their low-molecular-weight heparin but should also be educated to walk around with good compression. Until now the important principle of avoiding the venous stasis associated with bed rest has found broad acceptance in the field of primary prevention of venous thromboembolism. Modern antithrombotic management of patients with acute venous thrombosis should include early ambulation in conjunction with appropriate compression therapy.

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Arguments Favoring Bed Rest in Acute DVT

Up to the present time, physicians were taught to use this approach at least for the acute stage of DVT, hoping to avoid embolization of a proximal clot that can result in a serious or even fatal pulmonary embolism (PE). Walking with acute DVT may be painful without appropriate compression and it is assumed that bed rest would alleviate pain and swelling more effectively. Only a few studies exist that question these dogmas.

The aim of this article is to show that in mobile outpatients presenting with acute DVT, walking exercises with good compression will produce better results.

Ambulation and Compression Does Not Cause Clinically Relevant PE

Two randomized controlled trials have demonstrated that there was no statistically significant difference between the frequency of new PEs compared to a baseline lung scan if patients with proximal DVT are treated with LMWH and either kept in bed or ambulated with leg compression. In one study, 129 patients with proximal DVT were randomized to either immobilization for 4 days or ambulation for 4 hours per day under supervision with a compression bandage. All patients were screened for PE at baseline and at day 4 by ventilation-perfusion (V/Q) lung scans, and were followed up for a total of 3 months. The frequency of PE at baseline was 53.0% and 44.9% in the bed rest and ambulatory groups, respectively. During the 4-day observation period, new PEs were found in 10% of bed-rest patients and in 14.4% of those
who were ambulated (difference, 4.4%; 95% confidence interval [CI] 0.5 to 13.8; \( \chi^2 = 0.569, P = .44 \). All of the PEs in this study were asymptomatic. Twelve of the 16 new PEs occurred among patients with a positive ventilation-perfusion scan at baseline. No patients died during the 4-day observation period. After 3 months, two patients from the bed-rest group and three from the ambulating group died. Cause of the death was malignancy in all patients. The authors conclude that incidence of PE is not increased by early ambulation and suggest that early mobilization is safe.

In a study from Schellong et al., patients with proximal DVT were randomly assigned to strict bed rest for 8 days or to begin full ambulation at day 2. All patients received LMWH, overlapping with oral anticoagulants and compression therapy using elastic bandages or graduated compression stockings. Serial ventilation/perfusion single photon emission-computed tomography scans were done on day 1 and days 8 to 10. Sixty-two patients were randomly assigned to a group that received 8 days of bed rest and anticoagulation and 64 to a group that performed ambulation beginning on the second day after the initiation of LMWH. New PEs were detected in 10 of 59 patients assigned to the group that received bed rest and in 14 of 63 patients from the ambulatory group (\( P < .25; \) power, 0.8). PE was symptomatic in one patient in the bed-rest group. The authors conclude that the prescription of bed rest as a part of the initial treatment of DVT does not reduce incidence of scan-detectable PEs enough to have a major impact on clinical outcome.

In a prospective cohort study we have reported the results of 1,289 consecutive, mobile patients admitted with acute symptomatic DVT. All patients were treated with LMWH, compression, and immediate ambulation. V/Q scans were performed at admission and repeated after 10 days. On admission positive lung scans were found in 190 of 356 (53.4%) patients with iliofemoral, in 355 of 675 (52.6%) cases with femoral and in 84 of 239 (35.1%) patients with lower leg vein thrombosis. The difference between the incidences of PE in patients with proximal venous thrombosis compared to PE seen in patients with isolated lower leg vein involvement was statistically highly significant (\( P < .001 \)). Two-thirds of the PEs detected by scintigraphy were completely asymptomatic. After 10 days new PEs were seen in 7.4%, 6.4%, and 3.4% of patients, respectively. Only 6 of 77 patients with scan-detected new PEs had mild pulmonary symptoms. Seventeen patients (1.3%) in this series died during hospital stay and all underwent autopsy. Only three of these deaths were attributed to pulmonary emboli (0.23%) and all patients were older than 76 years. Twelve patients died from malignancy.

The results of these studies demonstrate that about half of the ambulatory patients presenting with proximal DVT have pulmonary emboli when the diagnosis of DVT is confirmed (Table 1). Most of these patients do not have any symptoms suggestive of PE. When the patients are treated with LMWH, compression, and active walking exercises, the incidence of new, symptomatic pulmonary emboli is exceedingly rare. Mortality from PE depends mainly on the severity of comorbid conditions. The incidence of fatal PE of 0.23% (95% CI, 0.048–0.678) in our series is much lower than that of 2.33% as reported in a retrospective multicenter study of 1,647 patients with DVT treated by unfractionated heparin and bed rest in different centers of Germany.

Based on these data, we conclude that the threat of fatal PE is obviously minimal when ambulatory patients with acute DVT receive properly dosed LMWH and are encouraged to walk with appropriate compression bandages or stockings. The key concept here is to keep the ambulatory patient with acute DVT ambulating with appropriate compression.

### Table 1 Randomized Controlled Trials Investigating the Frequency of Pulmonary Embolism in DVT Patients Treated by Bed Rest or Mobilization*

<table>
<thead>
<tr>
<th>Schellong et al</th>
<th>Aschwanden et al</th>
<th>Partsch et al</th>
</tr>
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<tbody>
<tr>
<td><strong>Proximal DVT (n)</strong></td>
<td><strong>Walking</strong></td>
<td><strong>Bed Rest 8 Days</strong></td>
</tr>
<tr>
<td>Compression Bandages or stockings</td>
<td>63</td>
<td>59</td>
</tr>
<tr>
<td>PE (before therapy)</td>
<td>62%</td>
<td>71%</td>
</tr>
<tr>
<td>New PE (second scan)</td>
<td>22%, day 8-10</td>
<td>17%, day 8-10</td>
</tr>
<tr>
<td>Symptomatic new PE</td>
<td>0</td>
<td>1.7%</td>
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DVT, deep vein thrombosis; PE, pulmonary embolism.
All patients received low-molecular-weight heparin.
PEs were assessed by repeat ventilation/perfusion single photon emission-computed tomography or V/Q scan. There was no statistically significant difference between the mobile and bed-rest groups.

### Ambulation and Compression Reduces Stasis and Thrombus Propagation

Bed rest promotes venous stasis, which may enhance thrombus propagation and may also increase the risk of fatal pulmonary emboli, especially in older patients. For the primary prevention of thromboembolic diseases, compression and early ambulation in order to avoid venous stasis has become an acknowledged principle. However, for the secondary prevention of new episodes in the presence of acute DVT, antistasis principles are widely neglected. In general, the fear...
of dislodging clots by ambulation is more common than the consideration of thrombus propagation and of recurrence.

Hull and coworkers\(^7\) have shown that the first 24 hours after diagnosing DVT play a deciding role regarding the recurrence rate in the next 3 months. This could probably be true not only for the quality of initial anticoagulant response to heparin as shown by Hull et al but also for the kind and amount of antistasis measures in this crucial period. Putting a patient into bed for 24 hours obviously promotes thrombus propagation during this time.\(^8\) Therefore, after diagnosis of DVT is verified and LMWH is initiated, patients should be encouraged to ambulate immediately. Patients do very well provided that the leg compression is strong enough.

Seventeen years ago, Shulman\(^18\) was able to demonstrate, in a retrospective analysis of phlebographic studies, that thrombus propagation occurred in 26% if patients were kept in bed for more than 5 days, compared with 1% if mobilization was started between days 0 and 2.\(^18\) At this time most studies using repeated phlebography showed thrombus progression in about 20% to 30% when patients with DVT were treated conventionally with bed rest and intravenous infusions of unfractionated heparin.\(^19\)

These data are in good agreement with newer studies comparing intravenous with subcutaneous injections of different heparin compounds. In one study using a reduction in the Marder score as a primary endpoint, recanalization was achieved more frequently (43%) when the LMWH was administered subcutaneously compared to the same drug given intravenously (35%) \((P = .11)\).\(^20\) In another trial intravenous administration of unfractionated heparin for 1 week was compared with the subcutaneous administration of a LMWH, given either once daily for 4 weeks or twice daily for 1 week.\(^21\) LMWH treatment resulted in a statistically significant phlebographic improvement, given once or twice daily as compared with intravenous unfractionated heparin \((P < .001)\). This study also revealed a correlation between clinical recurrence and change in thrombus size \((P < .001)\).

As usual, in most therapeutic DVT studies the important question of physical activity was not addressed in either of these trials. It may be assumed that the intravenously treated patients were predominantly at bed rest for the infusion period, which was more than 12 days\(^20\) or 1 week\(^21\) respectively. The inferior phlebographically documented reopening rate could therefore be attributed to the lack of mobility in patients treated intravenously. These data suggest that bed rest inhibits thrombus regression in contrast to physical activity.

We have performed a randomized, controlled trial on 53 patients with proximal DVT, comparing bed rest for 9 days without compression with walking exercises either using compression stockings or bandages.\(^22,23\) All patients were treated with therapeutic doses of LMWH. Thrombus size was assessed by duplex examination on days 0 and 9. An increase in the length of the thrombus in the femoral vein was seen in 40% of individuals in the bed-rest group, and in 28% of those who were encouraged to walk with compression bandages or stockings. Due to the small number of patients, the difference was not statistically significant. However, the thrombus size showed a statistically significantly greater enlargement in those patients confined to bed compared to ambulatory patients with compression therapy \((P < .01)\).

### Ambulation and Compression Leads to Faster Relief of Pain and Swelling

Pain and swelling of the leg with symptomatic DVT have considerable subjective relevance for the patient’s quality of life. Until now these parameters have been widely neglected in most studies concentrating on therapeutic outcomes.

In the above-mentioned randomized controlled trial on 53 patients with proximal DVT treated with dalteparin, 200 IU/kg per body weight, 18 patients received strong Unna boot bandages, 18 thigh-length European class II compression stockings, and 17 patients underwent bed rest with no compression. In the ambulatory compression groups the walking distance measured by a pedometer was between 600 and 12,000 m per day.

With strong compression of their legs, patients could walk better immediately; after 9 days, leg circumference and pain level were significantly lower in the compression groups compared with the bed-rest group \((P < .01)\).\(^22\) Pain level was assessed by visual analogue scale and also by the application of increasing pressure to the calf using a blood pressure cuff (modified Lowenberg test). Both methods showed much faster pain reduction in the walking groups, especially in the first 3 days. The Lowenberg test reflects a more objective parameter for pain and allows a fair comparison between walking and bed rest in patients who would not experience pain as long as they do not walk. In contrast to the walking groups with compression, which showed a continuous pain relief starting in the first days, this test revealed a constantly elevated level of leg pain in the bed-rest group after 3 days of initial improvement. The completely rigid zinc plaster bandages, applied with a pressure on the distal lower leg of about 50 mm Hg, gave better results than elastic stockings exerting a pressure of about 35 mm Hg. The difference in calf circumference between both legs was taken as a parameter for edema. Before treatment this difference was more than 2 cm on average in all three groups. After 9 days only a mild and insignificant reduction of swelling was observed in the bed-rest group while both groups treated with walking and compression were nearly free from edema. It should be stressed that no specific leg elevation had been advised during bed rest.

There was a significant improvement of the DVT-related impairment of quality of life in the compression groups compared with the bed-rest group \((P < .001\) for bandages, and \(P < .05\) for the stocking group). No significant difference was found in the incidence of new PEs assessed by repeated V/Q-scan.\(^23\)

Aschwanden and co-workers\(^10\) did not find a significant difference of pain score assessed by visual analogue scale and of leg circumference between bed rest with leg elevation and walking with bandages after 4 days. In the mobile group, pain
was also assessed during exercise, and showed a highly significant decrease after 4 days.

**Ambulation and Compression Reduces Frequency and Severity of Postthrombotic Syndrome**

Limited data are available to address the question of late sequelae years after DVT, depending on the quality of anticoagulation, appropriate compression, and ambulation. Two randomized controlled trials were able to demonstrate that minimizing venous stasis by wearing compression stockings after proximal DVT reduces the frequency and severity of the postthrombotic syndrome during the next few years. In both studies, compression stockings were started only 10 to 14 days after the acute onset of DVT.

In order to evaluate an additional potential benefit of immediate compression, we have followed our patients who had been enrolled in our above-mentioned randomized controlled trial. Thirty-seven patients could be reinvestigated after 2 years on average, 11 from the bed-rest group, 13 from the bandage group, and 13 from the stocking group. At the time of the follow-up, compression stockings were still routinely used by 73% of the bed-rest group patients and by 50% of the patients who had been kept mobile. With immediate compression 9 of 11 patients treated initially by bed rest, but only 16 of 26 patients from the mobile groups showed a larger circumference on the diseased leg.

Taking the Villalta-Prandoni score as an acknowledged criterion to quantify subjective symptoms and objective signs of a postthrombotic syndrome, there was a significantly better outcome in the groups who actively walked with compression immediately after diagnosing DVT than in the immobilized group. No postthrombotic syndrome according to the score was present in 18 of 26 mobile patients but only in 2 of 11 who had bed rest initially. These results indicate that immediate mobilization with good compression in the acute stage of DVT may add to the beneficial effects of subsequent wearing of compression stockings to prevent the postthrombotic syndrome.

Recurrent episodes of DVT, many of them asymptomatic, are among the most important risk factors for development of the postthrombotic syndrome. However, prevention of new episodes of DVT by wearing compression stockings has not yet been demonstrated.

**Ambulation and Compression—A Dispelling Myth?**

The last consensus conference of the American College of Chest Physicians recommends ambulation as tolerated for patients with DVT. We believe that ambulation under compression is an active treatment modality and not just avoidance of bed rest. The idea to apply firm bandages and to keep patients with DVT mobile has an old tradition in Europe. In 1910, Heinrich Fischer, a pupil of Unna, recommended firm zinc plaster bandages (Unna boots) and walking exercises to treat patients with thrombosis. Since then, this tradition of ambulation under compression was practiced in several centers but data in the literature remain scarce.

After LMWH compounds were approved for therapy of venous thromboembolism, the question of ambulation gained new popularity. Due to the fact that these agents can be injected subcutaneously without special laboratory monitoring, home therapy of VTE without restriction of ambulation became feasible for selected patients. In the future, the information brochures for home-care patients should not only explain injection technique and emergency measures but should also give clear advice concerning physical activity and compression.

**Conclusion**

For many indications bed rest is a potentially rather harmful treatment modality needing more careful evaluation. This holds also true for symptomatic, mobile outpatients with DVT. Regardless of the location of the thrombi, we start treatment with therapeutic doses of LMWH and encourage mobile patients to walk as much as possible with good compression. For therapists who are not familiar with the application of a strong and well-fitting short stretch bandage, good quality, class II–III compression stockings may be an alternative. Compression should be recommended at least for 1 year. Then it may be decided if it should be maintained, depending on the residual signs and symptoms. More studies are needed to elucidate the role of compression and walking in patients suffering from venous thromboembolism.

**References**