Home Treatment of Deep Vein Thrombosis

An Out-Patient Treatment Model with Once-Daily Injection of Low-Molecular-Weight Heparin (Tinzaparin) in 555 Patients

Leif Lapidus Jens Börretzen Martin Fahlén Hans Grönlund Thomsen Sverker Hasselblom Lars Larson Henrik Nordström Lennart Stigendal Lotte Waller

Department of Internal Medicine, Sahlgrenska University Hospital, University of Göteborg, Göteborg, Sweden

Key Words
Deep vein thrombosis · Home treatment · Low-molecular-weight heparin

Abstract
During a 22-month period, 555 consecutive patients at seven hospitals in the western part of Sweden with an acute deep vein thrombosis (DVT) not involving the iliac vein and not having pulmonary embolism were included in a study testing the efficacy of implementing outpatient treatment. For all patients with a confirmed diagnosis of acute DVT, a folder was used that contained two checklists with detailed instructions for further treatment, one for the doctor and one for the nurse, an information pamphlet for the patient and prepared prescriptions for low-molecular-weight heparin (LMWH) tinzaparin (Innohep®) of 175 anti-Xa IU/kg body weight subcutaneously once daily and warfarin. Patients not requiring hospitalisation, according to strict guidelines, were then eligible for treatment as out-patients. Prior to release from the emergency department for home treatment, a nurse provided detailed information to the patient and administered the first tinzaparin injection. In 194 (35.0%) out of 555 patients, the DVT was localised only in the lower leg not reaching the popliteal vein. Factors predisposing to venous thromboembolism were identified in 35.0% of the patients. 332 (59.8%) out of the 555 patients studied did not require hospitalisation and were therefore treated as out-patients. 140 of these patients (42.2%) injected themselves, the injection was given by a relative in 63 (19.0%) patients and by the community nurse in 129 (38.9%). Six (1.8%) patients reported a worsening of the DVT condition during the LMWH treatment period. No major bleedings were observed during the injection treatment period. Except for local minor skin bleedings at the injection site, only 3 (0.9%) patients reported minor bleedings during the injection treatment period. Recurrences of venous thromboembolism during the first 2 months were reported in 9 patients (2.7%) out of 332 patients who were sent home from the emergency department. Five (2.2%) patients out of the 223 who were admitted to the hospital had an increased tendency to bleeding. Twelve patients (5.4%) were hospitalised because of a pronounced local status, 26 (11.7%) were senile, social factors were the reason for hospitalisation in 76 (34.1%) and lack of time of the physician in 39 (17.5%) of the patients. A pharmacoeconomic analysis found a cost reduction of 69% with the present model for home treatment compared with traditional in-hospital
treatment of DVT patients. We conclude that tinzaparin can be safely used at home by patients with DVT below the inguinal region and that the model used in the present study is cost-effective.

**Introduction**

Treatment of acute deep vein thrombosis (DVT) with a low-molecular-weight heparin (LMWH) has been shown to be effective and safe [1, 2] even when given on an outpatient basis [3–5]. The proportion of patients with DVT who are being treated at home varies considerably both internationally and regionally. The risk of bleeding and thrombotic complications is believed to be the most important reason for treatment in the hospital but another common reason for hospitalisation is that a thorough home treatment protocol is not available to the doctor in the emergency department or that the doctor does not have enough time to give the patient sufficient information for treatment at home.

We therefore believe that clear and structured guidelines/checklists for the doctor on duty at the emergency department including continuing education on guideline use are necessary to identify the true proportion of patients who can be safely treated at home.

The present study was conducted to answer the following questions:

1. How many patients with a DVT not reaching the iliac vein can be treated at home, when clear guidelines, including strict criteria for treatment in hospital, are given to the doctor on duty?
2. How often will an easily accessible community nurse give the injection, and how often will it be given by the patient or a relative?
3. What are the frequencies of bleedings or recurrent thromboembolism with home treatment?
4. What is the economic impact of home treatment of DVT?

**Subjects and Methods**

All patients suffering from an acute DVT not involving the iliac vein and not having symptoms of pulmonary embolism at seven hospitals in western part of Sweden were studied during a 22-month period.

The patients were referred to or consulted a doctor at the emergency department and after a clinical examination a referral to the Department of Radiology was considered.

**Results**

**Study Population**

Altogether 555 patients, 256 (46.1%) men and 299 (53.9%) women had a DVT not involving the iliac vein and were thus included in the study (table 3). The mean age was 65 years, range 21–95 years. A family history of venous thromboembolism was reported by 78 (14.2%)
Table 1. Checklist for doctor on duty

Deep vein thrombosis (DVT) below the inguinal ligament

Checklist for doctor on duty
(checklist to be initialled and attached to the case notes)

<table>
<thead>
<tr>
<th>Patient:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor:</td>
<td>Initials:</td>
</tr>
</tbody>
</table>

**Inform** about diagnosis and treatment; hand over patient pamphlet

**Include in status** palpation per rectum (>45 years), breasts and lymph nodes

**Lab**
1. Hemoglobin, platelet count, APTT, PT prompt analysis
2. WBC, ESR, calcium, creatinine, AST, ALT, bilirubin, alkaline phosphatase

**Referrals**
1. X-ray lungs (if smoker or symptoms or clinical findings)
2. Pelvic examination (if symptoms or palpable resistance in abdomen)

**Consider thrombolysis** if pronounced local status, <60 years, history <7 days and no tendency to bleeding

**Indications for admission and/or dose reduction**
- Current haematuria or melena
- Acute ulcer (treatment initiated during the last 4 weeks)
- Serious liver disease (INR >1.3)
- Renal insufficiency requiring dialysis
- Thrombocytopenia (platelet count <100 000) or known heparin-induced thrombocytopenia
- Known coagulation disorder
- Intracerebral bleeding less than 2 months ago
- Damage or operation of CNS, eyes or ears during previous 14 days
- Uncontrolled hypertension (>200/110)

**Other indications for admission**
- Pronounced local status
- Pregnancy
- Signs of pulmonary embolism
- Expected lack of compliance (dementia or alcohol abuse) when appropriate care not available
- Other disease which requires diagnostic work-up and treatment in hospital

**Prescription** warfarin 2.5 mg 100 tabl

| Day 1 | 12.5 mg |
| Day 2 | 7.5 mg (5 mg if >70 years or <60 kg) |
| Day 3 | 3.75 mg (2.5 mg if >70 years or <60 kg) |
| Day 4 | PT |

**Duration of treatment**
- Idiopathic or irreversible risk factor: 6 months (longer if irreversible)
- Reversible risk factor or calf vein thrombosis (below v. poplitea): 3 months

**Prescription for Innohep graduated single-use syringes 20,000 anti-Xa IU/ml 6 syringes**

<table>
<thead>
<tr>
<th>kg</th>
<th>ml</th>
<th>kg</th>
<th>ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 ml</td>
<td>30</td>
<td>0.25</td>
<td>0.7 ml</td>
</tr>
<tr>
<td>35</td>
<td>0.30</td>
<td>70</td>
<td>0.60</td>
</tr>
<tr>
<td>40</td>
<td>0.35</td>
<td>75</td>
<td>0.65</td>
</tr>
<tr>
<td>45</td>
<td>0.40</td>
<td>80</td>
<td>0.70</td>
</tr>
</tbody>
</table>

The first Innohep dose to be reduced according to the following:
- 06–15 h full dose
- 15–21 h 75% dose
- 21–03 h 50% dose
- 03–06 h 25% dose

The dose is to be further reduced by 0.15 ml if the patient has received a prophylactic dose (= Innohep 3,500 IU) prior to ultrasound/phlebography during the last 3 h

The following days, a full dose to be given in the morning until INR >2, minimum 5 injections. If the first dose is 50% or less (including prophylactic dose) then at least 6 injections should be given. The first injection is preferably administered by the thrombosis nurse, within 30 min after results of acute tests. If pain is not pronounced, free mobilisation allowed even before first injection.

The thrombosis nurse at the anticoagulation clinic

Book visit before 15.00 h or next weekday 10.00 h, ask the nurse at the emergency ward to phone!

The patient should bring the case notes (Innohep and warfarin doses to be recorded) and the red folder (if the patient does not see the thrombosis nurse the same day, the case notes should remain in the dictation room.) If Friday after 16.00 h or weekend day, the patient should go home without compression stockings during the weekend but advised to have the leg frequently elevated and then go to the thrombosis nurse on Monday 10.00 h.

Inform the patient that the district nurse can help if problems arise with the administration of the injection.
Table 2. Checklist for thrombosis nurse

<table>
<thead>
<tr>
<th>Deep vein thrombosis (DVT) below the inguinal ligament</th>
<th>Patient:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checklist for thrombosis nurse (checklist to be initialled)</td>
<td>Nurse:</td>
<td>Initials:</td>
</tr>
</tbody>
</table>

Normal response to tests for hemoglobin, platelet count, APTT and PT prior to Innohep injection

Innohep injection administered (to be given immediately upon arrival of normal test results)
The district nurse to be contacted (if necessary)
U – Erythrocytes, faeces – hemoglobin × 3
Anticoagulation tag and anticoagulation pamphlet handed over
PT control on day 4 at the anticoagulation clinic (if weekend day: day 3 or day 5)

Ankle measure (b-measure):
Calf measure (c-measure):
(after 30 min elevation on a wedge-shaped bolster)
Compression stockings tested
Appointment for follow-up with doctor after 2 months

Table 3. Characteristics of subjects

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Men</th>
<th></th>
<th></th>
<th>Women</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td></td>
<td>n</td>
<td>%</td>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Included in the study</td>
<td>256</td>
<td>46.1</td>
<td></td>
<td>299</td>
<td>53.9</td>
<td></td>
<td>555</td>
</tr>
<tr>
<td>Age</td>
<td>62.4</td>
<td>(23–90)</td>
<td></td>
<td>67.2</td>
<td>(21–95)</td>
<td></td>
<td>65.0</td>
</tr>
<tr>
<td>Family history of DVT</td>
<td>37/253</td>
<td>14.6</td>
<td></td>
<td>41/298</td>
<td>13.8</td>
<td></td>
<td>78/551</td>
</tr>
<tr>
<td>Major disease last 2 months</td>
<td>121/254</td>
<td>47.6</td>
<td></td>
<td>140/296</td>
<td>47.3</td>
<td></td>
<td>261/550</td>
</tr>
<tr>
<td>Physically active</td>
<td>131/253</td>
<td>51.8</td>
<td></td>
<td>151/298</td>
<td>50.7</td>
<td></td>
<td>282/551</td>
</tr>
<tr>
<td>DVT in lower leg only</td>
<td>101/256</td>
<td>39.5</td>
<td></td>
<td>93/299</td>
<td>31.1</td>
<td></td>
<td>194/551</td>
</tr>
<tr>
<td>Predisposing factors</td>
<td>62/256</td>
<td>24.2</td>
<td></td>
<td>53/297</td>
<td>17.8</td>
<td></td>
<td>115/553</td>
</tr>
</tbody>
</table>

1 Data expressed as mean (range).
2 DVT in parents, siblings or children.
3 Includes chronic diseases.
4 Except family history of DVT.

Home Treatment

332 (59.8%) out of the 555 patients studied were treated at home (table 4). 140 of these patients (42.2%) injected themselves, the injection was given by a relative in 63 (19.0%) patients and 129 (38.9%) patients were injected by the community nurse. 222 (67%) of the patients treated at home had seven or less injections, but 15% needed 10 injections or more.

Only 7 (2.1%) out of 330 patients who answered the questionnaire were not satisfied with the information from the nurse. Two (1.0%) patients out of 203 who injected themselves or were injected by a relative reported problems with the injections. Six (1.8%) patients reported impairment (pronounced local status or more pain) during the injection treatment period.

No major bleedings were observed during the tinzaparin treatment period. Except for local minor skin bleedings at the injection site, only 3 (0.9%) patients out of 330 who answered the questionnaire reported minor bleedings during the injection treatment period. Recurrences during the first 2 months were reported in 9 (2.7%) patients out of 330 who answered the questionnaire.
Table 4. At-home treatment characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
</tr>
<tr>
<td>Treated at home</td>
<td>164/256 64.1</td>
<td>168/299 56.2</td>
<td>332/555 59.8</td>
</tr>
<tr>
<td>Injection by patient</td>
<td>62/164 37.8</td>
<td>78/168 46.4</td>
<td>140/332 42.2</td>
</tr>
<tr>
<td>Injection by relative</td>
<td>35/164 21.3</td>
<td>28/168 16.7</td>
<td>63/332 19.0</td>
</tr>
<tr>
<td>Injection by community nurse</td>
<td>67/164 40.9</td>
<td>62/168 36.9</td>
<td>129/332 38.9</td>
</tr>
<tr>
<td>Number of injections</td>
<td>6.3</td>
<td>6.4</td>
<td>6.3</td>
</tr>
<tr>
<td>Satisfied with information</td>
<td>158/162 97.5</td>
<td>165/168 98.2</td>
<td>323/330 97.9</td>
</tr>
<tr>
<td>Impairment during injection period</td>
<td>4/162 2.5</td>
<td>2/167 1.2</td>
<td>6/329 1.8</td>
</tr>
<tr>
<td>Major bleedings (injection period)</td>
<td>0/162 0</td>
<td>0/168 0</td>
<td>0/330 0</td>
</tr>
<tr>
<td>Minor bleedings (injection period)</td>
<td>2/162 1.2</td>
<td>1/168 0.6</td>
<td>3/330 0.9</td>
</tr>
<tr>
<td>Recurrences during 2 months</td>
<td>4/164 2.4</td>
<td>5/168 3.0</td>
<td>9/332 2.7</td>
</tr>
</tbody>
</table>

1 Local minor skin bleedings at the place for injection excluded.

Table 5. In-hospital treatment characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
</tr>
<tr>
<td>Treated at hospital</td>
<td>92/256 35.9</td>
<td>131/299 43.8</td>
<td>223/555 40.2</td>
</tr>
<tr>
<td>Reasons for hospitalisation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleeding</td>
<td>2/92 2.2</td>
<td>3/131 2.3</td>
<td>5/223 2.2</td>
</tr>
<tr>
<td>Local status</td>
<td>7/92 7.6</td>
<td>5/131 3.8</td>
<td>12/223 5.4</td>
</tr>
<tr>
<td>Suspection of PE</td>
<td>16/92 17.4</td>
<td>22/131 16.8</td>
<td>38/223 17.0</td>
</tr>
<tr>
<td>Senility</td>
<td>11/92 11.9</td>
<td>15/131 11.5</td>
<td>26/223 11.7</td>
</tr>
<tr>
<td>Social factors</td>
<td>33/92 35.9</td>
<td>43/131 32.8</td>
<td>76/223 34.1</td>
</tr>
<tr>
<td>Lack of time</td>
<td>17/92 18.5</td>
<td>22/131 16.8</td>
<td>39/223 17.5</td>
</tr>
</tbody>
</table>

PE = Pulmonary embolism.

of the 332 patients who were sent home from the Emergency Department. Two patients had pulmonary embolism and 7 had a new DVT. Eight of these 9 patients had a concurrent malignant disease. The recurrence occurred with INR values within the therapeutic range except in 2 patients who had marginally low INR values (1.8 and 1.9, respectively) at the time of the recurrence.

Hospital Treatment

Five (2.2%) patients out of 223 who were admitted to the hospital had an increased tendency to bleeding according to the definition in the doctor’s checklist (table 5). Twelve patients (5.4%) were hospitalised because of a pronounced local status, 26 (11.7%) were senile, social factors were the reason for hospitalisation in 76 (34.1%) and not enough time to give information by the physician in 39 (17.5%) of the patients.

Table 6 shows number of nights in hospital. Twenty-nine (13.0%) patients out of 223 stayed one night in hospital whereafter they continued with home treatment with LMWH and warfarin.

Cost Assessment

A comparison was made between the cost of treating patients according to the present home treatment model (sending the patient home from hospital when possible) and traditional standard in-hospital treatment for 6 days.

The time required by the different personnel categories (physician, thrombosis nurse and community nurse) has been estimated based on past clinical experience of doc-
Table 6. Number of nights for 223 patients treated in hospital

<table>
<thead>
<tr>
<th>Number of nights</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
<td>15.2</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>22</td>
<td>23.9</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>10.9</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>7.6</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3.3</td>
<td>9</td>
</tr>
<tr>
<td>≥6</td>
<td>36</td>
<td>39.1</td>
<td>57</td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
<td>100</td>
<td>131</td>
</tr>
</tbody>
</table>

Table 7. Cost description for the present model

<table>
<thead>
<tr>
<th>Number of nights/patients in hospital</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/29</td>
<td>7,888</td>
</tr>
<tr>
<td>2/46</td>
<td>25,024</td>
</tr>
<tr>
<td>3/24</td>
<td>19,584</td>
</tr>
<tr>
<td>4/19</td>
<td>20,672</td>
</tr>
<tr>
<td>5/12</td>
<td>16,320</td>
</tr>
<tr>
<td>≥6/93</td>
<td>151,776</td>
</tr>
<tr>
<td>Total</td>
<td>241,264</td>
</tr>
</tbody>
</table>

Extra costs for in-patients

- Physician: 76 USD
- Thrombosis nurse: 171 USD
- Community nurse: 766 USD
- Disposable syringes: 3,492 USD
- Total: 4,505 USD

Total cost for home treatment

- Physician: 3,302 USD
- Emergency department nurse: 1,311 USD
- Thrombosis nurse: 5,683 USD
- Community nurse: 3,743 USD
- Disposable syringes: 17,068 USD
- Total: 31,107 USD

Total cost: 276,876 USD

Costs for Standard In-Hospital Treatment

(555 Patients Admitted to Hospital for 6 Days)

We have calculated the cost based on a 6-day hospital stay for the 555 patients participating in this study.

Information on the total cost of hospital care SEK 2,719 (= 272 USD) per patient and day, was provided by the Economy Department of Sahlgrenska University Hospital. This covers all costs including staff time for doctors and nurses, laboratory tests and drugs.

If all the 555 patients had been admitted for 6 days each, the total treatment cost would have been 555 × 6 × 272 = 905,760 USD.

Costs for Present Model

(223 Patients Admitted to Hospital 1- to 6-Day Stays)

Costs for In-Hospital Patients. For comparison, costs for the present model were determined. In the current study, 223 patients were admitted to hospital with varying lengths of hospital stay. The total cost of in-hospital care for these 223 patients, with a total of 887 ward days, was 887 × 272 = 241,264 USD based on a daily cost of hospital care at 272 USD as above (table 7).

Additional Costs for the 130 Patients (of 223) Who Were Admitted to Hospital for 1–5 Days. These extra costs are added because discharge from hospital occurred during the injection treatment period and reflects the extra time required with the thrombosis nurse for consultation, injection by the community nurse and consultation with a physician. We estimated that 25% of the patients who were discharged from the hospital during the first 5 days needed extra consultation time with the thrombosis nurse, mean time per patient being estimated at 20 min.

Based on a time cost for the thrombosis nurse (including pay roll tax) of 15.8 USD per hour the cost for these consultations was estimated at 171 USD.

The cost for the community nurse giving the injections was calculated at 766 USD (51 patients, 140 visits) also based on the rate of 15.8 USD per hour and taking vehicle costs into consideration (estimated mean: 8 km per patient, 0.13 USD/km).

Similarly, additional telephone consultation with the physician for these 130 patients was calculated to 76 USD based on an estimation that 10% of the patients would need extra telephone consultations for 10 min and on a
time cost for the physician of 35.1 USD. Additional cost for disposable syringes is estimated at 3,492 USD.

Costs for 332 Patients Sent Home from the Emergency Department. 332 of the patients were sent home directly from the emergency department. We estimated extra physician consultation time (compared with patients who were admitted to the hospital) for these patients to be 15 min/patient (in the Emergency Department) and 10-min telephone contact with about 20% of the patients during the first week. Total cost for extra physician contact time is 3,302 USD. The nurse in the Emergency Department was estimated to need 15 min extra per patient at a total cost of 1,311 USD. The thrombosis nurse’s initial time required per patient is calculated to be 60 min with an additional 20 min estimated for 25% of the patients with a total cost of 5,683 USD. Costs for the community nurse are estimated to be 3,743 USD. Additional costs for disposable syringes are estimated to be 17,068 USD.

The total cost for the 555 patients in the described model is thus 276,876 USD; the saving thus amounts to 628,884 USD (69.4%) compared to conventional in-hospital treatment.

Discussion

As far as we know, previous studies have required patient consent before the implementation of home treatment. However, based on positive results from such studies [3–5], the patients were not given that possibility in our study. If the physician on duty determined that the patient could receive home treatment, following strict guidelines, then the patient was not admitted to hospital care. Therefore the results of this study were not steered by individual patients’ concerns of being able to carry out their own treatment in the home setting. The current study confirms previous studies’ findings that out-patient treatment is cost effective which further points to the importance of the determination of the proportion of patients with DVT that can be treated in the home setting. During the study period all patients with DVT were included in the study and since informed consent was not required by the study design we were able to determine the eligibility for home treatment based solely on well-defined criteria for hospital admission.

Nearly 60% (332 out of 555) of the patients could be sent home directly from the Emergency Department and another 99 patients (17.8%) were discharged after only 1–3 days of in-hospital treatment. Tendency for bleeding was given as reason for hospital admission in a few cases while social factors and lack of time available to the doctor on duty was a more common reason. Taking these factors into account, we therefore estimate that home treatment may be the appropriate means of treatment for more than 60% of patients with DVT not reaching the iliac vein.

The purpose of using a patient folder containing detailed checklists for the physician on duty and for the thrombosis nurse is to provide clear criteria for hospital admission and to reduce the risk of missing important steps in determining eligibility for out-patient treatment for the physician and the nurse when sending the patient home from the Emergency Department. The quality of the information received by the patient was judged to be acceptable by 98% of the patients as determined by a questionnaire. The proportion of patients who could self-inject or were injected by a relative was over 60%. Access to a community nurse for injection assistance (40% of patients) is of importance for the success of such a programme and if such a service is not available then a patient may be forced to visit the hospital on a daily basis for injection assistance.

We found that recurrences during current treatment with anticoagulants were nearly always in patients who also had cancer.

Since we did not have a control group, we are not able to assess changes or improvements in the quality of life experienced under home treatment rather than in hospital. On the other hand, the cost estimates show a considerable economic advantage of utilising home treatment, as we did in the present study.

In conclusion, we found that our method of treating DVT with structured instructions for duty physician and thrombosis nurses was safe and cost saving. Training of doctors and nurses is imperative as well as the establishment of a network of community nurses. We believe that home treatment of DVT will have all the requirements to be a standard treatment form for most DVT patients.

Acknowledgements

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References


