



# Treatment of patients with pulmonary embolism entirely in Hospital in the Home

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## BACKGROUND

Low molecular weight heparin (LMWH) has revolutionised the management of venous thromboembolism (VTE). An important feature of the use of LMWH is the ability to manage acute VTE in the home. This study examined the outcomes of patients with pulmonary embolism (PE) who were transferred to Hospital in the Home (HIH) within 24 hours of presentation for treatment with LMWH.

## METHODS

The authors reviewed records of all patients with PE who presented to two major hospitals in Melbourne (Victoria) and who were transferred to HIH for treatment with LMWH within 24 hours of presentation. The main outcome measures were length of stay, unexpected staff callouts, unexpected returns to hospital, recurrent embolism, bleeding, and death.

## RESULTS

Twenty-one patients were included in the study over 5 years, with a mean age of 56 years. Patients spent a mean of 9 hours in hospital before transfer and spent a mean of 6 nights in HIH. One patient required an unexpected staff callout. There were no unexpected returns to hospital. No patient deaths or instances of major bleeding were recorded. Three patients developed minor bleeding.

## DISCUSSION

Despite the long study period, this is a small cohort of patients and no control group is offered. However, all eligible patients were included in the study. With appropriate risk assessment and medical model of HIH, it might be safe to treat low risk patients with PE in HIH for their entire hospital stay.

**Low molecular weight heparin (LMWH) has revolutionised the management of venous thromboembolism (VTE) and it compares favourably with unfractionated heparin (UFH) in the treatment of deep vein thrombosis (DVT) and acute pulmonary embolism (PE).<sup>1</sup> An important feature of the use of LMWH is the ability to manage acute VTE in the home.**

The most common manifestation of VTE is the isolated DVT. Bates and Ginsberg<sup>2</sup> concluded in 2004 that '(Hospital in the Home) with LMWH is safe and effective. If there is a system in place for administering the medication and for monitoring, more than 80% of patients can be treated without hospitalisation'. Cochrane reviewers<sup>3</sup> also supported the home based management of acute DVT with LMWH, however the review did raise the possible disadvantage for a patient treated at home who suffers a complication. Growing evidence suggests that LMWH is a safe and effective alternative to UFH for

the treatment of submassive PE.<sup>6-8,10-14</sup> *Table 1* describes rates of recognised complications in treating PE with LMWH.

There is less agreement on the treatment of patients with PE at home. A British Thoracic Society review<sup>1</sup> suggests that half of patients with PE could be managed without traditional hospitalisation, provided that care is taken in selection. Other authors are more guarded in their assessment of the safety of such an approach.<sup>4</sup>

In the absence of direct evidence, Hospital in the Home (HIH) units have become increasingly involved in the treatment of PE.<sup>5,10</sup> Other influences include: seemingly natural extension of involvement in the treatment of DVT; increased familiarity and confidence in the use of LMWH; initial treatment of PE in groups such as the terminally ill, patients with dementia, and those patients refusing traditional hospital admission; introduction of better tools for assessment (eg. portable pulse oximeters); and increased medical skills in HIH units.

**Table 1. Comparative adverse event rates in studies examining the use of LMWH in pulmonary embolism**

Study	N	Notes	Death rate	Major bleeding	Minor bleeding	Recurrent PE	Unplanned return to hospital
Prandoni <sup>7</sup>	720	No home group	3.3% in 90 days	0.8% in 90 days	None recorded (NR)	3.9% in 90 days, 1.1% in first 14 days	NR
Simonneau <sup>8</sup>	612	No home group	1.3% in first 8 days	1% in first 8 days	NR	1% in first 8 days	NR
Columbus <sup>13</sup>	1021	No home group; mixed PE and DVT	NR for PE alone	NR for PE alone	NR for PE alone	3% in first 14 days	NR
Matisse <sup>11</sup>	2213	Home subgroup	NR	NR	NR	3% in 90 days	NR
Wells <sup>12</sup>	194	All at home	7% in 90 days, 0 in first 14 days	2% in 90 days	5% in 90 days	3.6% in 90 days	63 visits in 90 days
Ong <sup>10</sup>	130	All at home, 46% entirely at home	0 in first 7 days, 3% in first 30 days	1.5% in first 7 days, 2% in first 30 days	NR	5% in first 30 days	11% in first 30 days

If LMWH is an acceptable therapeutic alternative for the treatment of acute submassive PE, the important issue for clinicians, hospitals, and patients to consider in supporting treatment at home is safety. In particular, they will be concerned about the consequences of expected complications such as recurrent VTE or bleeding.<sup>5</sup> Studies have generally examined home based treatment as a small subgroup of patients in clinical trials of PE treated with LMWH.<sup>6-8</sup> The duration, impact and organisation of home based care have not been clearly documented in those trials. In any assessment of the outcome of HIH care where care is divided between hospital and home, the preceding hospital stay and management will be a confounder. Little work has specifically addressed the home based treatment of an entire episode of acute PE; the usefulness of HIH as an intervention is maximised by its ability to substitute for the entire episode of care.

The aim of this study was to examine the outcomes of patients with newly diagnosed submassive PE who are referred immediately after diagnosis for acute home based treatment with LMWH.

## Methods

The authors conducted a retrospective, record based review of all cases of PE referred to HIH for treatment where the patient was transferred to HIH within 24 hours of the patient's arrival at hospital.

The study was conducted at two sites. Epworth Hospital is a not for profit private hospital with a medically managed HIH since 2000. Cases were identified from all admissions between June 2000 to August 2005. The Royal Melbourne Hospital is a large public hospital with a medically managed HIH since May 2004. Cases were identified from all admissions between June 2004 and August 2005.

Both units have adopted a clinical unit model of HIH.<sup>5</sup> Important features of this model are shown in *Table 2*.

Identification of cases with a discharge diagnosis of PE was made using the HIH units' databases and central hospital databases. Records were retrieved and reviewed by the authors.

*Table 3* shows the criteria for the admission of patients directly into HIH care.

The Geneva score<sup>9</sup> for severity of PE,

on which the criteria in *Table 3* were based, suggest that a poorer outcome can be expected where the patient has active cancer, new right heart failure, hypoxia, DVT on doppler study, hypotension or previous DVT.

Outcome measures were death during HIH admission, unplanned return to hospital, unplanned staff callouts during HIH admission, and complications (recurrent PE, bleeding episode or other). These have been derived from the Australian Council on Healthcare Standard's adopted clinical indicators for HIH<sup>15</sup> and from outcomes reported in previous studies of LMWH in PE.

The data collected from the hospital record are shown in *Table 4*.

## Results

Twenty-one eligible patients were identified. These patients spent between 0–24 hours in the emergency department, with a mean of 9 hours. Eleven (52%) were from The Royal Melbourne Hospital; 10 (48%) from Epworth Hospital.

Five (23.8%) patients were already current HIH patients with a diagnosis of DVT undergoing treatment at home. In each case, symptoms

**Table 2. Important features of the clinical unit model of HIH**

- Patients remain inpatients during their stay in HIH, and the hospital is responsible for their assessment, treatment and monitoring
- Patients are admitted under the care of the HIH medical staff, who are hospital staff. Medical staff assess, negotiate management, visit the patient daily at home, and are on call 24 hours. They manage LMWH and warfarin dosing
- HIH nursing staff are members of the HIH team; no externally contracted nursing services were used. HIH nursing staff assess and deliver care, including collecting blood samples. There is 24 hour HIH nursing cover for HIH patients
- Patients do not self inject LMWH
- All drugs, investigations, transport are provided by the hospital
- Only patients who would otherwise require hospital admission are considered for HIH

**Table 3. Criteria for admission of patients directly into HIH care**

- Submassive pulmonary embolism on imaging
- Haemodynamically stable
- Adequate oxygenation on room air
- No evidence of new heart failure or deteriorating function
- No contraindication for anticoagulation
- A carer at home

of breathlessness or chest pain had required a return to hospital for investigation, and a PE was diagnosed. In all five cases, the patients returned to HIH, consistent with other patients in this population.

Patients were aged 22–84 years (mean 56). Twelve (57%) patients were female; nine (43%) were male.

Fifteen patients (71%) were treated in their own home; (24%) were treated at a relation's home. One patient was treated in a Medihotel.

Twenty-seven separate contributing factors were identified in 15 (72.4%) patients. Travel

had occurred in eight cases, five patients had recent surgery, six had a history of previous VTE, three had a strong family history, and four of the 12 female patients were taking the oral contraceptive pill and undergoing hormone therapy. One patient had bowel cancer and associated chemotherapy.<sup>1</sup>

Important comorbidities were identified in 11 patients. These were: obesity, type 1 diabetes, renal impairment, hypertension, peptic ulcer disease or gastro-oesophageal reflux disease, depression, schizophrenia, emphysema, osteoporosis, dementia, stroke, carcinoma bladder, and atrial fibrillation.

### Diagnosis of PE

Nineteen patients (90.5%) had a ventilation perfusion (VQ) scan for diagnosis. Of these, 17 (81%) showed high probability for PE; two (9.5%) showed medium probability. Three patients (14.3%) had a computerised tomography (CT) pulmonary angiogram, one of whom had previously had a VQ scan showing medium probability of PE. Multiple or bilateral segmental involvement was described in the majority of patients (12, 57.1%).

Nine (42.9%) patients had a DVT proven in the current episode. The remaining patients did not have a venous doppler study of the limbs. No patient in this group had echocardiography. The minimum oxygen saturation at transfer to HIH was 92% on room air, with a mean saturation of 96 (92–100).

### Treatment

Twenty patients (95.2%) were treated with twice daily LMWH; one patient was treated with daily injections. Twenty patients (95.2%) were treated with enoxaparin; one patient was treated with fraxeparin. Warfarin was also initiated in all cases.

Mean length of stay in HIH was 6 nights (range 3–11).

### Safety

One patient (4.8%) experienced an unplanned staff callout to investigate and manage palpitations. No episode of an unexpected return to hospital was recorded. No death was recorded.

Treatment was complicated by nonmajor

bleeding in three cases (14.3% of total). One patient had moderately severe epistaxis. One post-transurethral resection patient had haematuria. A further patient had vaginal bleeding. All were considered cases of minor bleeding and treatment was modified but continued. One received a dose of oral vitamin K. No recurrent embolism was detected.

Three patients had an extra diagnosis at discharge: one had a proven factor V Leiden mutation (heterozygote), and two had lung lesions strongly suspicious of cancer of the lung.

### Discussion

This study is obviously limited by its small size and lack of a control group. Its incidence of adverse events – specifically major bleeding and recurrent PE – are lower than other reported studies. This may reflect fewer cancer patients, closer supervision or individualised dosing regimens. In our group, one patient was known to have active bowel cancer, and two further patients were found likely to have cancer of the

**Table 4. Data collected from the hospital record**

- Age and gender
- Contributing or causative factors for VTE identified
- Comorbidities
- Diagnosis and extent of PE
  - lobes/segments/unilateral/bilateral
- Vital signs on transfer
- Echocardiography performed
- Venous doppler of limb
- Time spent in the emergency department
  - number of hours from time first seen by doctor to time of transfer home
- Place of treatment
- Treatment undertaken
- Length of stay
  - nights in HIH
- Complications
  - bleeding, recurrent embolism, other
- Unplanned staff callouts
- Unplanned return to hospital
- Death during admission
- Extra diagnosis at discharge
  - diagnosis other than PE found or suspected at discharge

lung. Although this meant that 14.3% of our sample was affected by cancer, cohorts in other studies included patients in the terminal phase of their illness.

It is difficult to derive relevant organisational comparative information from many studies. Importantly, most home based interventions involve either self administration of LMWH or nurse only care teams. In many studies, outcomes are reported for 3 month periods, rather than for the period of the acute inpatient episode in which treatment is initiated (the area of interest for HIH intervention).

However, despite these limitations, we suggest that with a clinical unit model of HIH and adequate risk assessment and monitoring, it may be safe to transfer patients with submassive PE – even those with multiple segments – directly into HIH for treatment with LMWH. This finding should support the conduct of a controlled trial of home versus hospital care for the entire episode of treatment. However, the numbers of patients who meet the selection criteria are relatively few. A controlled trial of whole of episode PE management will therefore require multiple sites and long recruitment. It is also likely that centres that already undertake the treatment of PE at home will be reluctant to participate in a controlled trial in which half the HIH group will be required to remain in hospital.

These issues are common to the many existing applications of acute HIH care and those to be examined in the future. The rapid progress in medical technology and the willingness of the community and hospitals to consider well organised alternatives to traditional hospitalisation urge closer attention and more work in providing guidance on the best way to manage and deliver acute care at home.

Conflict of interest: none declared.

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