

Ambulatory investigation and treatment of patients with suspected pulmonary embolism: a retrospective review of one year's experience

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ABSTRACT The objective of this study was to establish the feasibility and safety of managing suspected and proven PE without overnight in-patient stay and was designed as a retrospective review of experience. The study took place at the AMU, Southampton General Hospital, Southampton, England. The participants were consecutive patients between October 2002 and 2003 with clinical features suggesting PE, requiring diagnostic imaging, and who fulfilled pre-defined community management criteria. The main outcome measures were anticoagulation complications, 30-day re-admission, PE within six months, and death any time following presentation. The results were as follows: 133 patients were identified, 22 of whom were treated in the community for PE without significant complications. Eight 30-day re-admissions were all in the 'PE excluded' group. One re-admission may have related to anticoagulant therapy. Five patients (4%) died during follow up. No deaths could be attributed to premature discharge or management in the community. The study concluded that selected patients with suspected and proven PE may be managed in the community within a carefully defined protocol, although larger studies are required to confirm the safety of this approach.

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LIST OF ABBREVIATIONS Acute medical unit (AMU), British Thoracic Society (BTS), computed tomography pulmonary angiography (CTPA), deep venous thrombosis (DVT), electrocardiogram (ECG), intensive therapy unit (ITU), low molecular weight heparins (LMWH), prospective investigation of pulmonary embolism diagnosis (PIOPED), pre-test probability (PTP), pulmonary embolism (PE), ventilation/perfusion (V/Q)

DECLARATION OF INTERESTS No conflict of interests declared.

INTRODUCTION

Suspected PE is a significant cause of emergency medical admission, accounting for approximately 5% of referrals to our department. Although the diagnosis is only confirmed in a minority of these patients, the incidence of PE is 60–70 cases per 100,000 with a hospital mortality of 6–15%.¹

The traditional approach to the management of suspected PE has involved in-patient treatment with heparin until the diagnosis can be confirmed or excluded. For those patients in whom the diagnosis is confirmed, in-patient treatment with heparin is usually continued for between five and seven days, until oral anticoagulation with warfarin can be established.

Low molecular weight heparins are now licensed for the treatment of PE.^{3,4} For many years, these drugs have been used in the community treatment of DVT; large scale

audits have demonstrated that this is both safe and effective² and the result has been a substantial saving in hospital bed-days. The widespread experience with community anticoagulation now raises the question of whether there are patients with suspected or proven PE who could be managed without in-patient treatment.

Evidence to support an ambulatory approach to PE treatment is mostly indirect. Ventilation/perfusion scanning of asymptomatic patients with confirmed DVT indicates that 40%–70% of patients have evidence of PE.^{5,6} Since it is not routine practice to undertake V/Q scanning on such patients prior to enrolling them in a community anticoagulant programme, it is likely that a large number of patients with PE are already being treated in the community without complications.

A prospective series of 81 patients with confirmed PE were managed exclusively as outpatients in a Canadian

TABLE 1 Scoring system for PTP.

Attribute	Score
Symptoms and signs of DVT	3-0
Heart Rate >100	1-5
Immobilisation \geq 3 consecutive days or surgery in past 3/52	1-5
Previous DVT / PE	1-5
Haemoptysis	1-0
An alternative diagnosis is less likely than PE	3-0
Malignancy (current or recent treatment)	1-0

Score <2: Low Probability

Score 2–6: Intermediate Probability

Score >6: High probability

study.⁷ This study excluded patients with hypoxia, severe pain, high risk for major bleed or other medical problems requiring admission. No significant adverse outcomes were reported in community treated patients. Another study found that mobilisation of patients with existing PE and proven DVT had no influence on the development of further PE.⁸ The British Thoracic Society recommended that the current organisations for outpatient management for DVT should be extended to include stable patients with PE.¹ However there are, to our knowledge, no UK studies or case series examining the feasibility or safety of this approach.

METHOD

1. Protocol for Community Investigation/Treatment of Suspected PE

During the period between October 2002 and October 2003, approximately 1,200 patients were referred to Southampton General Hospital with suspected PE. Patients were considered for community treatment if referred at a time when assessment by one of the two Acute Medicine Consultants at Southampton General Hospital was possible. Clinical PTP was calculated using the Wells score (see Table 1).⁹ Following exclusion of patients in whom clinical PTP was low (<2) with negative D-Dimer (Laboratory Elisa D-Dimer <250), patients were referred for diagnostic imaging. If the chest X-ray was significantly abnormal, or the patient was known to have underlying chronic lung disease, the patient was referred for CTPA; all other patients underwent V/Q scanning. Patients who could not be investigated on the day of referral were assessed by a Consultant in Acute Medicine according to the criteria in Table 2. Patients who met these criteria and who were deemed fit for discharge were allowed home, following subcutaneous administration of 1.5 mg/kg Enoxaparin. Patients returned daily for treatment, or were given daily Enoxaparin injections in their home by a District Nurse,

TABLE 2 Criteria for community management of PE.

Criteria for management in the community

- No breathlessness at rest.
- No hypoxia – Oxygen saturations >97% on air or P02 >10 kpa.
- No tachycardia – Heart rate <100/min.
- No evidence of right ventricular strain on I2 lead ECG – if present, patient may be discharged if echo shows normal right heart pressure.
- No clinical evidence of DVT – if clinical evidence of DVT, patient may be discharged if duplex scanning is normal or shows DVT confined to the calf veins.
- No history / evidence of underlying chronic lung disease.
- No other significant pathology requiring in-patient treatment.

until the first available investigation slot could be identified. This also ensured each patient had daily contact with a medical professional. The patients all received verbal and written advice to seek urgent medical help via A&E if they became more short of breath, felt more unwell or developed abnormal bleeding. Patients were also given a 24-hour telephone number to contact staff on the AMU, who would provide advice and support if needed.

Following diagnostic imaging, patients were reassessed by the acute medical team. Pulmonary Embolism was considered to have been confirmed if the V/Q scan appearances were high probability for PE using PIOPED criteria,¹⁰ or if evidence of thrombosis was seen on CTPA. Where scans were negative or indeterminate, the need for further investigation and/or treatment was reconsidered, along with the patient's fitness to continue treatment in the community if required. Follow-up was arranged at the discretion of the doctor assessing the patient.

Patients with confirmed PE on imaging were re-assessed according to the criteria in Table 2. If their condition had not deteriorated since their initial assessment, community anticoagulation with Enoxaparin and continuing warfarin was initiated, according to our standard protocol for DVT patients. Written and verbal advice was reinforced. All patients with confirmed PE were followed up after one week and again in outpatients after three months.

2. Retrospective review of data

A list of patients undergoing diagnostic imaging for PE from the AMU was generated from Radiology and Nuclear Medicine records. This was cross referenced with the hospital Patient Administration systems confirming the group managed via the community treatment programme. Notes were reviewed and the hospital Patient Administration and A&E computer systems were

TABLE 3 Summary of Results.

	Treated as PE (n=22)	PE Excluded (n=111)
Age (years) [median (range)]	60 (20–83)	51 (18–86)
Male Sex [number (%)]	9 (41%)	36 (32%)
30 days readmission [total (%)]	0	8 (6%)*
PE within six months of presentation	0	0
Deaths during follow-up** [total]	3	2

*four related to initial reason for presentation (cardiac failure, pneumonia, paroxysmal atrial fibrillation, acute coronary syndrome); 1 complication of heparin; 3 unrelated reasons.

**all directly due to underlying malignancy (lung, colon, mesothelioma, melanoma, glioblastoma), none related to community treatment.

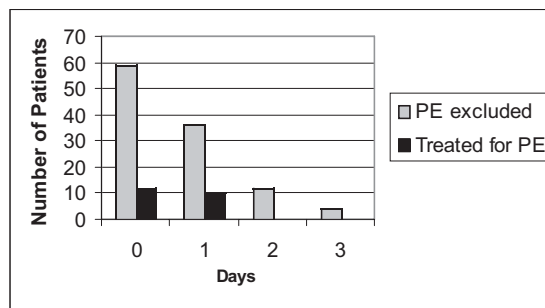
interrogated for evidence of undocumented admissions or attendances during the six months following their initial attendance. Where patients had died at any time following their attendance, the reasons for this were established by careful review of their notes and hospital discharge summaries.

RESULTS

Between 1 October 2002 and 1 October 2003, 137 patients were referred with symptoms and signs requiring formal diagnostic imaging for possible PE, and fulfilled criteria for community treatment. Four patients have not been included due to missing notes or incomplete records. Eighty-nine patients (67%) were female. Age ranges of the group are shown in Table 3. Of these, 62 patients could not undergo imaging on the day of referral, and were allowed home pending investigation (see Figure 1). One hundred and twenty-two patients underwent V/Q, and twelve patients underwent CTPA imaging. PE was proven in 18 patients (16 from V/Q, two from CTPA), ten of whom were women. One patient, subsequently treated for PE, required both V/Q and CTPA imaging. Imaging was inconclusive in ten patients; in six of these, treatment was provided for an alternative diagnosis on clinical grounds; in four cases, PE could not be excluded and community anticoagulation was initiated and continued for six months.

READMISSIONS

Eight patients (6%) were re-admitted within 30 days of investigation, none of whom had confirmed PE or an adverse outcome during their initial or subsequent investigation. In one case the patient was admitted, under

**FIGURE 1** Delay to investigation.

the care of the gynaecologists, with vaginal discharge, 24 hours after investigation for PE, and was found to have a vault haematoma. This patient had received one dose of Enoxaparin, which could have precipitated the bleed. No other complications of anticoagulation were identified. It is likely that the cause of some readmissions was related to the original reason for presentation (see Table 1). None of the patients with negative or indeterminate investigation developed PE during the six months of follow-up, although eight further unrelated readmissions were recorded during this period.

DEATHS

Five patients died during the follow-up period, three of whom had confirmed PE on imaging. None of these deaths could be attributed to community investigation or treatment. One patient with known metastatic colon cancer and one patient with mesothelioma, both of whom had received community treatment for confirmed PE, died several weeks after their investigation; in each case the death was attributed to their underlying diagnosis rather than to complications of PE or anticoagulation. The other patient was admitted electively under the cardiothoracic team for investigation of a mass, identified on the CT which had confirmed the presence of PE. Following surgery, which confirmed the diagnosis of lung cancer, the patient developed renal failure and haemorrhagic CVA and died thirteen days later on ITU. The remaining deaths, where PE was excluded, were attributed to glioblastoma multiforme and metastatic melanoma, and occurred after eight months and two months respectively.

DISCUSSION

Pulmonary embolism can be a serious condition, with potentially life-threatening consequences. Patients referred to hospital with suspected PE should be assessed carefully, and undergo rapid investigation according to a clearly defined protocol. Any patient who shows evidence of haemodynamic or respiratory compromise should be admitted, treated and closely observed in a high dependency area. This group, however, represents only a small minority of patients referred to hospital with suspected PE, many of whom have a much less sinister

cause for their symptoms. Pleuritic-type chest pain, in our experience the most common reason for referral to hospital with suspected PE, is usually musculoskeletal or infective in origin. Rapid assessment, followed by investigation with chest X-ray, ECG, blood gases and D-Dimer may enable immediate exclusion of PE. When the possibility of PE persists, diagnostic imaging is required. If this is delayed, or if a small pulmonary embolism is confirmed, in-patient monitoring and anticoagulation is normally undertaken. Our data suggests that there is a group of such patients for whom outpatient investigation and treatment may be feasible.

The small numbers of confirmed PE in our group should lead to caution in interpreting the results. It is very likely that more patients admitted during the study period fulfilled outpatient treatment criteria, but were not included because they presented outside the times at which assessment by a consultant in Acute Medicine was possible. We were naturally concerned to ensure very careful and consistent supervision of any patient being assessed for community management. Since October 2003, we have widened the criteria for such treatment to include patients assessed by the on-call or Acute Medicine Specialist Registrar, although still within the tight boundaries defined in Table 1. These criteria were based on those used by Kovacs *et al*⁷ and intended to ensure exclusion of patients who had undergone major PE who would be at risk of haemodynamic collapse or significant respiratory compromise. The guidance to undertake lower limb venous doppler in patients with leg swelling was designed to identify patients with co-existent extensive DVT who could be at risk of further significant PE; patients with DVT extending into the femoral vein would all be admitted for a minimum of 48 hours, in line with our policy for community DVT treatment.

The overall re-admission rate for this group was lower than the average rate for our Directorate; however this may, in part, have reflected the highly selected nature of the patients. Furthermore, it is important to note that the most significant morbidity and all early re-admissions occurred in patients in whom PE had been excluded. Although overall outcome was not adversely affected in patients re-admitted, it is likely that these re-admissions were caused by the same problem which precipitated the original referral; admission to hospital might have led to treatment being initiated sooner. It is crucial to emphasise that exclusion of PE in patients referred to hospital with pleuritic chest pain or breathlessness does not imply exclusion of all significant pathology. Identification and treatment of any alternative diagnosis is important. If the diagnosis is unclear and symptoms are ongoing, careful follow-up is required if the patient is not admitted to hospital. Our revised protocol now requires that patients with persistent symptoms are re-assessed in our Medical Assessment Centre within one week of initial presentation even if PE has been excluded.

Co-existent malignancy is well recognised in patients with suspected or proven PE,¹¹ and was responsible for all of the deaths in our patient group. In all of these cases the diagnosis was known at the time of referral, so further investigation was not deemed necessary. Our normal practice requires that patients with proven DVT or PE where no clear explanation can be identified, undergo careful clinical assessment, blood tests and imaging, as guided by clinical findings, to exclude underlying malignancy. The two patients with metastatic malignancy who died while being treated for their confirmed PE were keen to avoid hospital admission; in both cases the cancer was at an advanced stage and community anticoagulation enabled them to spend more time at home, while improving symptoms resulting from their PE. Both patients' families expressed their gratitude at being able to avoid hospital admission. If such patients are managed outside hospital, it is likely that complication rates, including bleeding complications, will be higher.¹² Careful discussion with the patient and their family is crucial in this situation.

The proportion of patients in whom PE was excluded was high. This is likely to be a further reflection of the highly selected patient group. The fact that 16% of those investigated were ultimately treated for PE supports the need for such investigation in this patient group. Our diagnostic algorithm enables patients with low PTP and negative D-Dimer to be discharged without further imaging. However, when the PTP is intermediate or high, or where the D-Dimer is positive in the context of symptoms suspicious for PE further investigation is undertaken. Referrals with suspected PE have risen progressively over the past five years in our hospital, probably as a result of increasing fears of litigation from a missed diagnosis, as well as increased public awareness of the condition. Many of those referred fulfil the criteria defined in Table 2. It is clearly important to ensure that such patients do not consume excessive health resources by inappropriate in-patient investigation or treatment. Rapid availability of diagnostic imaging would avoid the need for in-patient treatment in many cases, in the absence of a community treatment programme. However, limited availability of Krypton for V/Q scanning and the overstretched CT scanning service have prevented such scanning from being available on a daily basis. Currently, V/Q scanning is available in our Trust on Mondays, Wednesdays and Fridays, while emergency CTPA has to be negotiated on an individual basis, and is fitted around pre-booked out-patient lists. This experience is shared by many hospitals in the UK, with availability of investigations particularly limited at weekends. The BTS recommends that diagnostic imaging be undertaken within 24 hours in all patients.¹ This target was achieved in 89% of our patients.

An estimated 438 acute medical bed days were saved during the study period, assuming an in-patient stay of six days following confirmation of PE. Although this is a relatively small saving, it is likely that the number of patients suitable for community treatment in the future will increase if the protocol is extended to include patients referred at weekends and out-of-hours. It should be noted that development of this protocol was only possible because of the support infrastructure, which was provided by our existing community anticoagulant treatment programme for

DVT. Our Medical Assessment Centre, which incorporates our DVT clinic, provided a trolley-based facility in which patients could be assessed, monitored and followed up. Community anticoagulation support was provided by the specialist nurses in the DVT clinic and district nurses. The association of this service with the AMU, along with the relatively small number of patients, has so far enabled the community treatment of PE to be undertaken without additional investment. Future extension of the service may have resource implications.

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