



Safety of outpatient management of pulmonary embolism diagnosed in the emergency department

Talal Alkhalidi¹ · Nathan Hecht¹ · Michael Y. Woo¹ · Marie-Joe Nemnom² · Ian Stiell^{1,2}

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Abstract

Objectives Pulmonary embolism is a serious condition requiring accurate diagnosis, management, and risk stratification to guide treatment and disposition. While outpatient management for pulmonary embolism may be safe for select patients, its application in the emergency department (ED) setting remains uncertain. This study aimed to evaluate the safety of outpatient management for patients presenting to the ED with pulmonary embolism.

Methods This was a health-record review of patients with confirmed pulmonary embolism in 2 large EDs of a tertiary care hospital. Stable patients were discharged by the ED physicians, usually without consultation and patients were seen in a specialized thrombosis clinic within 48 h. Anticoagulation follow-up was coordinated through the thrombosis clinic. We reviewed electronic hospital records using a standardized data collection form. The primary outcome was return to the ED within 5 days due to early clinical deterioration requiring escalation of treatment. Descriptive statistics are presented.

Results Out of the 300 patients initially screened, 253 patients had confirmed pulmonary embolism and were evaluated in this review. Ten were excluded (3 admitted for another reason, 5 were discharged by the consulting service, 1 left against medical advice, 1 died in the ED). Of the 243 patients in the final analysis, 101 patients (41.6%) were discharged and managed as outpatients, whereas 58.4% required hospital admission. The discharged patients were younger (mean age 55.0 vs. 64.9 years) and 61.4% received direct-oral anticoagulants. Of these discharged patients, nine (8.9%; 95% CI 4.8–16.1%) returned to the ED within a 5-day period. Five (5.0%) returned due to pulmonary embolism, none suffered clinical deterioration, and none were admitted; of four patients who returned for other reasons (4.0%), none suffered clinical deterioration, and two were admitted.

Conclusion Outpatient management of low-risk pulmonary embolism was safe, with no deterioration or escalation of care observed. These findings demonstrate the feasibility of safely discharging low-risk patients by the ED physician with appropriate follow-up, potentially reducing unnecessary hospital admissions.

Keywords Emergency medicine · Pulmonary embolism · Anticoagulation · Thrombosis

Résumé

Objectifs L'embolie pulmonaire est une affection grave qui nécessite un diagnostic précis, une prise en charge et une stratification des risques pour guider le traitement et la disposition. Bien que la prise en charge ambulatoire de l'embolie pulmonaire puisse être sans danger pour certains patients, son application dans le contexte des services d'urgence (SU) reste incertaine.

✉ Talal Alkhalidi
talkhalidi@toh.ca

Ian Stiell
istiell@ohri.ca

¹ Department of Emergency Medicine, The Ottawa Hospital, University of Ottawa, Ottawa, ON, Canada

² Ottawa Hospital Research Institute, University of Ottawa, Ottawa, ON, Canada

Cette étude visait à évaluer la sécurité de la prise en charge ambulatoire pour les patients se présentant au service d'urgence avec une embolie pulmonaire.

Méthodes Il s'agissait d'une revue des dossiers de santé de patients présentant une embolie pulmonaire confirmée dans deux grands hôpitaux tertiaires. Les patients stables ont été renvoyés par les médecins de l'ED, généralement sans consultation et les patients ont été vus dans une clinique spécialisée en thrombose dans les 48 heures. Le suivi de l'anticoagulation a été coordonné par la clinique de thrombose. Nous avons examiné les dossiers électroniques de l'hôpital à l'aide d'un formulaire normalisé de collecte de données. Le critère principal était le retour à l'urgence dans les 5 jours en raison d'une détérioration clinique précoce nécessitant une escalade du traitement. Des statistiques descriptives sont présentées. We reviewed electronic hospital records using a standardized data collection form. The primary outcome was return to the ED within 5 days due to early clinical deterioration requiring escalation of treatment. Descriptive statistics are presented.

Résultats Sur les 300 patients initialement dépistés, 253 patients avaient confirmé une embolie pulmonaire et ont été évalués dans cette revue. Dix ont été exclus (3 admis pour une autre raison, 5 renvoyés par le service de conseil, 1 resté contre avis médical, 1 décédé à l'urgence). Sur les 243 patients de l'analyse finale, 101 (41,6 %) ont été libérés et traités en ambulatoire, tandis que 58,4 % ont nécessité une hospitalisation. Les patients sortis de l'hôpital étaient plus jeunes (âge moyen 55,0 ans vs 64,9 ans) et 61,4 % ont reçu des anticoagulants oraux directs. Parmi ces patients libérés, neuf (8,9 %; IC à 95 % 4,8-16,1 %) sont retournés à l'urgence dans un délai de 5 jours. Cinq patients (5,0 %) sont retournés à l'hôpital en raison d'une embolie pulmonaire, aucun n'a présenté de détérioration clinique et aucun n'a été admis; sur quatre patients qui sont retournés pour d'autres raisons (4,0 %), aucun n'a présenté de détérioration clinique et deux ont été admis.

Conclusion La prise en charge ambulatoire de l'embolie pulmonaire à faible risque était sûre, sans détérioration ni escalade des soins. Ces résultats démontrent la faisabilité de renvoyer en toute sécurité les patients à faible risque par le médecin ED avec un suivi approprié, ce qui pourrait réduire les admissions hospitalières inutiles.

Mots-clés Médecine d'urgence · embolie pulmonaire · anticoagulation · thrombose

Introduction

Acute pulmonary embolism represents a medical emergency that requires accurate diagnosis, risk stratification, and timely management. In North America and Europe, the annual incidence of pulmonary embolism is estimated to range from 0.75 to 2.69 cases per 1,000 individuals [1]. A systematic review and meta-analysis by Germini reported that, among patients evaluated for suspected pulmonary embolism, prevalence was approximately 8% in North American emergency department (ED), compared to 23% in European settings [2].

Outpatient management of pulmonary embolism is considered safe, with roughly 50% of cases deemed suitable for this approach [3, 4]. In one study, patients did not perceive out-of-hospital treatment as inconvenient, with no reported rise in anxiety levels [5]. However, studies specifically evaluating its safety when discharges are made by ED physicians without consultation remain limited. At our institution, hemodynamically stable patients presenting to ED and who do not require supplemental oxygen are typically managed by ED physicians, then discharged with follow-up at a specialized thrombosis clinic within 24 to 48 hours. They are usually anticoagulated with either a direct-oral anticoagulant or low-molecular weight heparin.

Given the paucity of evidence regarding an ED pulmonary embolism organization approach like that used at our

hospital, we aimed to assess the safety of outpatient management. We did this by determining whether these discharged patients returned within five days due to early clinical deterioration.

Methods

Design

We conducted a health records review using our hospital's electronic medical record (Epic Systems).

Setting

The study was conducted at two large academic EDs of The Ottawa Hospital in Ottawa, Ontario, Canada.

Participants

Study participants were at least 18 years old who were diagnosed with pulmonary embolism based on imaging results. Excluded from the final analysis were patients who were admitted for another reason than pulmonary embolism, were seen and discharged by a consulting service, left against medical advice, or died in the ED.

Ethics

This study was reviewed and approved by the Ottawa Health Science Network Research Ethics Board.

Case identification and data collection

With the assistance of The Ottawa Hospital Research Institute Analytics Department, potential cases were identified if pulmonary embolism was mentioned as a possible diagnosis. Final eligibility was determined by confirmation of pulmonary embolism on diagnostic imaging, usually computed tomography (CT) of the chest. Data were abstracted from patient records by the lead author (TA) using a standardized electronic data collection form. This data collection tool was revised after an initial review of 20 cases. Data were then entered into an Excel spreadsheet.

Outcome measures

The primary outcome was the safety assessed by return to the ED within five days due to early clinical deterioration. Early clinical deterioration was defined as hypotension (systolic blood pressure < 90 mmHg, a drop of > 40 mmHg from baseline, or shock index of > 1.0), new dysrhythmias or conduction abnormalities, escalation in management, respiratory failure, cardiac arrest, or death [6].

Data analysis

Descriptive statistics were performed. Frequencies with percentages are presented for categorical variables. Means with standard deviations (SD) or medians with interquartile ranges (IQR) are presented for continuous variables, as appropriate. We conducted all analyses using Statistical Analysis Software (SAS) version 9.4.

Results

Out of the 300 patients initially screened from April 2022 to May 2023, 253 patients had confirmed pulmonary embolism and were evaluated in the review. Ten were excluded (3 admitted for another reason, 5 were discharged by the consulting service, 1 left against medical advice, and 1 died in the ED). Of the 243 patients in the final analysis, 101 patients (41.6%) were discharged and managed as outpatients, whereas 142 (58.4%) required hospital admission due to clinical indications directly attributable to the pulmonary embolism diagnosis (see Table 1). Computed tomography chest with intravenous contrast was the most frequently used imaging modality, accounting for 239 (98.4%) of all enrolled

patients. Among the 101 patients discharged from the ED, 62 (61.4%) were treated with direct-oral anticoagulants, while the remainder received low-molecular weight heparin prior to discharge. Continuation of anticoagulation therapy was usually coordinated through the thrombosis clinic, as clinically indicated. Of the discharged patients, nine (8.9%; 95% CI 4.8–16.1%) returned to the ED within a 5-day period. Five (5.0%) returned due to pulmonary embolism, none suffered clinical deterioration, and none were admitted: (1) mild hemoptysis and dyspnea, (2) ED visit for direct-oral anticoagulant refill due to pharmacy closure, (3) chest pain with discharge and thrombosis clinic follow-up, (4) fatigue with negative workup, (5) chest pain managed symptomatically. Of four patients who returned for other reasons (4.0%), none suffered clinical deterioration, and two were admitted: (6) admission for failure to cope related to mesothelioma, (7) admission for post-mastectomy chest wall hematoma requiring evacuation, (8) upper limb musculoskeletal pain, and (9) IV antibiotics for diverticulitis.

Discussion

Interpretation

Outpatient management of pulmonary embolism in selected ED patients appears to be a safe strategy, particularly among younger individuals with stable clinical profiles. The majority of discharged patients were managed with direct-oral anticoagulants and none were seen by a consulting service. Discharged patients in our system are followed closely at a specialized thrombosis clinic. No patients returned to the ED with clinical deterioration requiring escalation of care. This model of care reduces the number of hospital admissions among ED patients with pulmonary embolism.

Previous studies

Several cohorts and trials have shown that outpatient management of acute pulmonary embolism is safe in carefully selected patients, particularly when guided by tools. More recently, the EARTH consensus investigators identified adverse outcomes that preclude home treatment, defined the relevant monitoring timeframe, and outlined high-risk features for early deterioration [7]. Our definition of early clinical deterioration overlaps with several of these outcomes, including hemodynamic instability, respiratory failure, cardiac arrest and need for escalation of care. However, unlike EARTH, these outcomes were assessed only among patients who re-presented to the ED within 5 days, rather than as a directly measured composite outcome over 7 days. Our shorter follow-up therefore captures early post-discharge

Table 1 Characteristics, outcomes, and management of 243 patients diagnosed with pulmonary embolism in the emergency department

Characteristic	Discharged from ED <i>n</i> = 101	Admitted to hospital <i>n</i> = 142
Age (years), mean (SD)	55.0 (16.7)	64.9 (15.4)
Range	19–83	20–98
Male, <i>n</i> (%)	49 (48.5)	75 (52.8)
Campus, <i>n</i> (%)		
Civic	43 (42.6)	66 (46.5)
General	58 (57.4)	76 (53.5)
Vital signs, mean (SD)		
Systolic blood pressure (mm Hg)	131.0 (20.5)	133.4 (26.5)
Heart rate, beats per minute	87.1 (16.1)	100.5 (21.4)
Respiratory rate, per minute	17.5 (2.4)	21.2 (5.5)
Oxygen saturation (%)	97.1 (2.1)	94.9 (4.0)
Room air, <i>n</i> (%)	100 (99.0)	68 (47.9)
Temperature, degrees Celsius	36.7 (0.5)	36.5 (0.5)
Electrocardiogram performed, <i>n</i> (%)	90 (89.1)	136 (95.8)
Imaging used to diagnose PE, <i>n</i> (%)		
CT chest with IV contrast	98 (97.0)	141 (99.3)
CT abdomen	1 (1.0)	0 (0.0)
CT cardiac with and without IV contrast	1 (1.0)	0 (0.0)
Ventilation perfusion scan	1 (1.0)	1 (0.7)
Type of pulmonary embolism, <i>n</i> (%)		
Acute	98 (97.0)	141 (99.3)
Subacute	3 (3.0)	0 (0.0)
Chronic	0 (0.0)	1 (0.7)
Troponin (ng/L), <i>n</i> (%)	71 (70.3)	136 (95.8)
Median (IQR)	9 (5–15)	39 (20–76)
Range	3–64	3–871
NT-proBNP (ng/L), <i>n</i> (%)	2 (2.0)	23 (16.2)
Median (IQR)	4,145 (131–8,158)	2,553 (736–4,299)
Range	131–8158	34–55,548
D-dimer (ug/L), <i>n</i> (%)	71 (70.3)	74 (52.1)
Median (IQR)	2,561 (1,474–4,729)	6,152 (3,531–13,353)
Range	190–37838	590–33,327
Management in ED, <i>n</i> (%)		N/A
Direct oral anticoagulants	62 (61.4)	
Low-molecular-weight heparin	39 (38.6)	
Thrombolysis	0 (0.0)	
Outpatient leg Doppler performed, <i>n</i> (%)	75 (74.3)	N/A
Deep vein thrombosis present	30 (40.0)	
Bilateral	3 (10.0)	
Unilateral	27 (90.0)	
Entire leg	12 (40.0)	
Isolated distal	11 (36.7)	
Isolated proximal	7 (23.3)	
Return to ED within 5 days, <i>n</i> (%)	9 (8.9)	N/A
Related to pulmonary embolism	5 (5.0)	
Admitted	0 (0)	
Other reasons	4 (4.0)	
Admitted	2 (2.0)	

safety but may miss later adverse events. In our cohort, outpatient management was based on clinical judgment, physiologic stability, and reliable early follow-up rather than formally applied criteria. We do not suggest that validated risk tools should be omitted; rather, our findings reflect real-world practice where their use may not be systematically documented. Notably, no patients experienced early deterioration or required escalation of care, which may in part relate to our structured follow-up pathway.

These findings are consistent with prior evidence. A systematic review by Maughen et al. reported very low 90-day rates of mortality, recurrent venous thromboembolism, and major bleeding among more than 1,800 low-risk outpatients in the direct-oral anticoagulant era [8]. Similarly, an individual patient data meta-analysis by Luijten et al. demonstrated extremely low short-term mortality and adverse event rates among patients discharged within 24 hours using validated triage tools [9]. Randomized trials using Hestia or PESI to identify low-risk patients showed that outpatient treatment reduced length of stay without increased adverse outcomes [10, 11]. Prior cohort studies and randomized trials of LMWH-based management reported low adverse event rates, absence of pulmonary embolism related mortality, and favorable patient acceptance within protocolized treatment frameworks [12–16]. Our study adds contemporary ED-based data in which pulmonary embolism was managed by emergency physicians, with predominant direct-oral anticoagulant use, and focuses on outcomes within the first five days post-discharge. We believe that our rapid thrombosis clinic follow-up is a key safeguard for safe outpatient pulmonary embolism management.

Strength and limitations

A key strength of this study is its specific focus on patients with pulmonary embolism discharged directly from the ED, a population that has been less well characterized in prior studies. In addition, the availability of a dedicated thrombosis clinic facilitated timely outpatient follow-up and supported safe discharge decisions.

This study, however, has several limitations. As a health-record review, it was subject to the accuracy and completeness of existing documentation. The relatively small sample size and single-center design may limit the generalizability of the results. In addition, the five-day follow-up period may not have been sufficient to capture delayed complications such as bleeding or delayed readmissions. While almost all patients in our system are seen promptly in the thrombosis clinic, we did not collect the exact numbers who did attend. Finally, we were unable to ascertain patient visits to other EDs in the area, which may have led to underestimation of subsequent presentations. Despite these limitations, the

study contributes meaningfully to the growing body of evidence suggesting that outpatient management of pulmonary embolism can be safe for appropriately selected patients, particularly when supported by structured ambulatory care pathways that ensure close follow-up and continuity of care.

Clinical implications

The findings of this study indicate that a substantial proportion of ED patients with pulmonary embolism can be safely discharged by the ED physician and managed in the outpatient setting. This approach carries important implications for both patient care and system-level efficiency. Safely reducing unnecessary admissions may help optimize resource utilization, alleviate ED and inpatient crowding, and improve overall patient experience. The implementation of structured outpatient pathways, including standardized discharge criteria, clear anticoagulation strategies, and timely follow-up with thrombosis services, has the potential to maintain high-quality care while enhancing safety. Broader adoption of such models may also support health-care cost containment and greater alignment with evidence-based emergency medicine practices.

Research implications

While this study supports the safety of outpatient management for selected patients with pulmonary embolism, important knowledge gaps remain. Future research should evaluate long-term outcomes to assess the durability of outpatient strategies. Prospective, multicenter studies are needed to enhance generalizability.

Conclusion

Outpatient management of low-risk pulmonary embolism was safe, with no deterioration or escalation of care observed in this cohort. These findings demonstrate the feasibility of safely discharging low-risk patients by the ED physician with appropriate follow-up, potentially reducing unnecessary hospital admissions.

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Declarations

Conflict of interest The authors have no conflicts of interest to disclose.

Ethical approval This study was approved by the Ottawa Health Science Network Research Ethics Board (OHSN-REB).

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