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An Ambulatory Pathway for the Investigation of Patients with Suspected Pulmonary Embolism

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Abstract

Aims

The aim of this project was to provide an ambulatory pathway for diagnosis and management of patients with suspected Pulmonary Embolism (PE) with "low-risk" features.

Methods

A structured algorithm for the management of suspected PE was designed and implemented in April 2021. This involved the development of local guidelines to identify those "low-risk" patients with suspected PE, through the use of modified sPESI and Hestia criteria. This pathway was audited monthly to establish effect on admission and hospital length of stay.

Results

51 CT PAs were performed by the Emergency Department in April 2021. Total number of CT confirmed PEs in April was 7(11%). 12 "low-risk" patients with suspected PE were identified and placed on the "Ambulatory Suspected Pulmonary Embolism Pathway". One (8.3%) patient on this pathway had a confirmed PE. Patients placed on this pathway spent significantly less time in the Emergency Department and in hospital with greater satisfaction by physicians using this pathway.

Conclusion

This pathway has succeeded in significantly decreasing length of stay both in the ED and in hospital for patients with suspected and confirmed PE.

Introduction

Pulmonary embolism (PE) is a common cardiovascular illness with incidence of 1 case per 1000, and suspected PE is a common cause of ED presentation, accounting for approximately 1.5% of all ED presentations [1-3] . While there is some variation internationally, for every positive CT Pulmonary Angiogram (CT PA) confirming the presence of a PE, approximately nine negative CT PAs will be performed. There is thus a large diagnostic burden of those with suspected PE on health systems [4]. The prognosis and treatment of people suspected of having PE is related to their initial haemodynamic status. High-risk PE (massive PE) is defined by the presence of shock or persistent arterial hypotension, and accounts for approximately 5% of all cases of PE, with a short-term mortality of more than 15%. Those with "low-risk", or haemodynamically stable PE, account for 95% of all PEs, and have a mortality which ranges from less than 1% to 15% [5-8].

Over the past 10 years there has been an increased drive to develop safe alternative pathways for investigation and treatment of many conditions traditionally managed as inpatients. The development of ambulatory pathways for the management of PE clearly provides an opportunity to improve patient experience, and to reduce hospital length of stay. There has been a significant effort to characterise these "low-risk" PEs, with literature suggesting 37%-44% of patients with confirmed PE may be suitable for ambulatory investigation and management [9, 10].

The British Thoracic Society (BTS) has developed guidelines on the outpatient investigation and management of suspected and confirmed PE in 2018 [11]. These guidelines recommend patients with suspected or confirmed PE should be assessed for suitability for ambulatory management, and if deemed low risk, out-patient management can be offered where a robust pathway exists for follow-up. To risk stratify patients with suspected or confirmed PE the simplified Pulmonary Embolism Severity Index (sPESI) score has been externally validated and can be used to determine those "low-risk" patients suitable for outpatient management[12]. The Hestia criteria are a series of clinical criteria for which discharge, and OP management is considered inappropriate[13], and can be combined with sPESI to ensure patients are exceptionally low risk for ambulatory management. sPESI and Hestia identify patients deemed low risk for out-patient management of confirmed PE. Although not validated for those with suspected PE, the British Thoracic Society has extrapolated these tools to identify those with suspected PE who are safe for outpatient management[11].

This paper details the implementation of an ambulatory pathway for the investigation of patients with suspected PE in an Irish ED, with the aim of reducing hospital admission and ED length of stay.

Methods

St. Vincent's University Hospital (SVUH) is a university affiliated ED, serving a population of over 300,000 people. SVUH has approximately 62,000 attendances per year.

To implement change and facilitate the primary aim of this quality improvement project, a simple and clear pathway was derived for the ambulatory management of suspected and confirmed PE, based on BTS 2018 guideline recommendations (Figure 1). This pathway provided a flow diagram which could be used by ED doctors and advanced nurse practitioners to aid decision making when managing a patient with suspected PE. The first segment of this flow pathway details the use of the WELLS score, and actions to take based on the WELLS score and PE Rule-out Criteria (PERC). Between the hours of 07:00 and 1800, a CT PA was performed on the same day. Out-of-hours (18:00-07:00), a hybrid of the sPESI and Hestia risk stratification tools were used to identify "low-risk" patients with suspected PE who would be suitable for ambulatory investigation. A hybrid of the sPESI and Hestia risk stratification tools were used to identify "low-risk" patients with suspected PE who would be suitable for ambulatory investigation. For patients commenced on this pathway, a patient information leaflet was provided (Figure 2). Pregnant patients and patients < 18 years old were excluded from this pathway due to lack of current evidence of safety.

Formal educational sessions were provided to both doctors and nurses demonstrating the use of the "Ambulatory pathway for patients with suspected PE". "Low-risk" patients who were deemed to require a CT PA during "on-call" hours were anticoagulated and were asked to return for their designated CT PA appointment the following morning, rather than being admitted.
This pathway was implemented in April 2021.

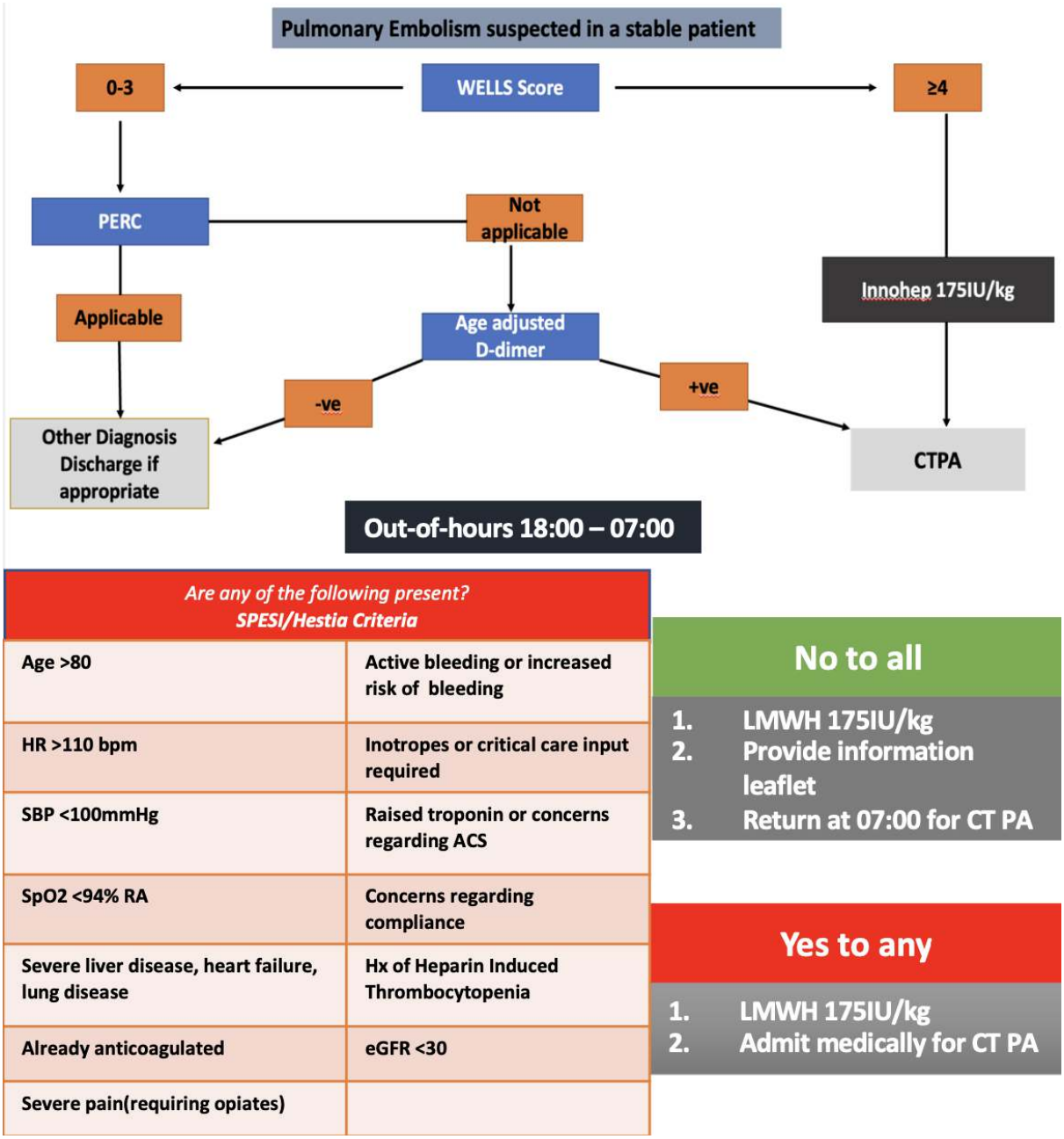

Figure 1: *Ambulatory pathway for patients suspected PE.*

Monthly audits were undertaken of CTPAs performed. Data was collected from SVUH radiology system, filtering for CTPAs performed from the ED. Results were analysed to establish positivity rate, as well as number of patients placed on the ambulatory pathway, which was noted in CT orders. The length of stay (LoS) of patients eligible for ambulatory investigation and management of suspected PE was compared pre- and post-pathway implementation.

Figure 2: *Patient Information Leaflet.*

ST. VINCENT'S UNIVERSITY HOSPITAL
Elm Park

Patient Information Leaflet: Suspected Pulmonary Embolus

UCD DUBLIN

This information leaflet has been provided as your doctor suspects you need further investigation to exclude pulmonary embolus as a cause for your symptoms.

What is a pulmonary embolus?

A pulmonary embolus (PE) is a where clot has travelled to the lung and blocked a blood vessel. It can cause symptoms such as chest pain or breathlessness. If left untreated this can be life-threatening.

How is a pulmonary embolus diagnosed?

A pulmonary embolus is diagnosed by a special scan called a CT Pulmonary Angiogram. This is pain-free and will take approximately 5 minutes.

Is it safe for me to go home?

Yes. Before you leave today, your doctor will give you an injection that will stop blood clots from getting bigger and prevent new clots forming, as well as breaking down any clot that may be present.

If a pulmonary embolism is found, what is the treatment?

If a PE is detected, you will continue with medication to treat this and your doctor will organise follow-up investigations and treatment. This may necessitate admission to hospital. The majority of people make a full recovery.

What do I do now?

You are safe to go home now. However, you must return to the **Emergency Department** tomorrow morning ____/____/____ at ____:____ for your CT Pulmonary Angiogram. After this scan is performed, please return to the Emergency Department for your results. This may take some time (approx. 1-2 hrs)

Please return if you have any of the following:

1. **Worsening shortness of breath**
2. **Worsening chest pain**
3. **Dizziness**
4. **Feeling that you may collapse**

St. Vincents' University Hospital Emergency Department, Elm Park, Dublin 4
Contact: 01 221 4422

A retrospective chart review was performed of patients presenting to the ED in October 2020. Details were collected, and the pathway applied to determine if these patients were suitable for ambulatory management. LoS in ED and hospital was collected for each patient deemed suitable for ambulatory management. This was compared with length of stay in ED and hospital for "low-risk" patients after the implementation of this pathway.

Statistical analysis was undertaken using SPSS V27 with descriptive statistics performed. M Mann-Whitney U test was applied to compare length of stay pre- and post- pathway implementation.

Results

A total of 51 CT PAs were performed in April 2021, with 55 performed in May 2021. These figures are comparable with monthly figures pre-pathway implementation (55 in March 2021). Both pre and post pathway implementation, more females than males had CTPAs performed for suspected PE. The average age was 59.6 years in October and 49.7 years in April.

	Oct-20	**Apr-21**	**May-21**
Sex			
Male	16 (34%)	12(25%)	15 (27%)
Female	30 (66%)	39 (75%)	50(73%)
Age (yrs)	59.6 (17.7 Std dev)	49.7 (15.1 Std dev)	54.2(18.5 Std.)
Mean Length of Stay (minutes)	1277 (506 Std dev)	436(165.7 Std dev)	460 (349 Std. Dev)
Total CT PA	46	51	55
Total Confirmed PE	5(10.8%)	7(13%)	5(9%)
No. of Patients on Pathway	0	12(23.5%)	15(27%)
No. of Confirmed PE on Pathway	0	0	1

Table 1: *Basic demographics. *p<0.05 (Mann-Whitney U test)*

7 patients were found to have a PE in April 2021, and 5 in May 2021, with no clinically or statistically significant difference observed (**Figure 3**).

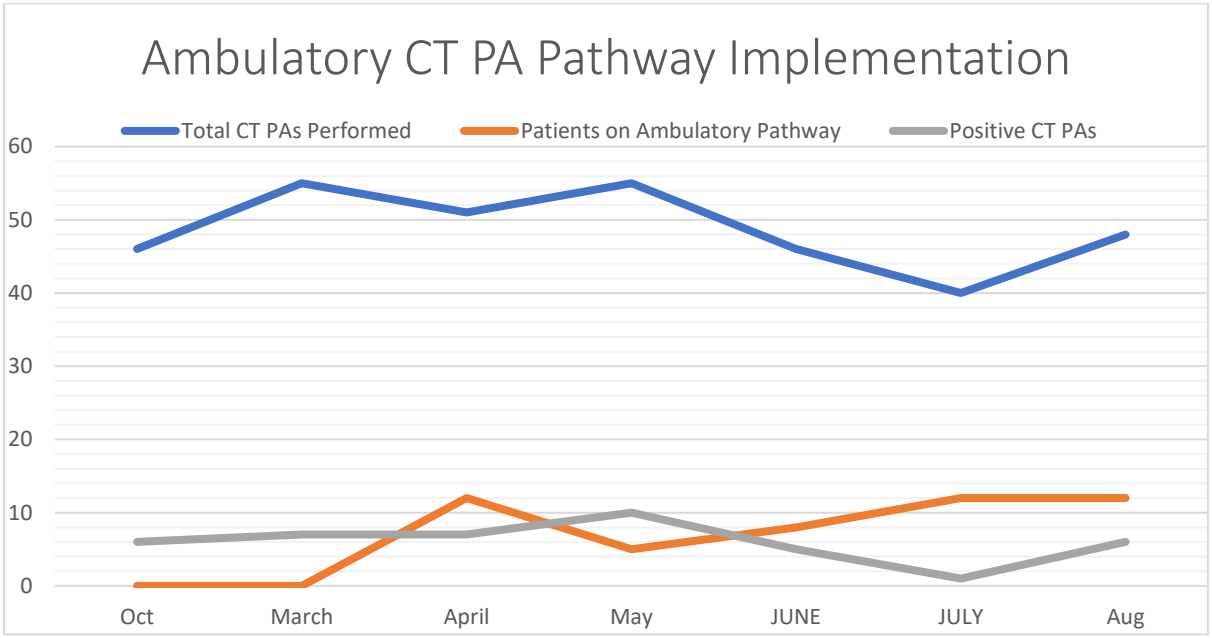

Figure 3: *Line graph showing total number of CT PAs performed, positive CT PAs and number of patients placed on ambulatory PE pathway.*

In April, 12 patients were placed on the ambulatory pathway for suspected PE. In May, 15 patients placed on the ambulatory pathway, representing 25% of all CT PAs performed across the month. Of the 27 patients placed on this pathway, 1 patient was found to have a PE confirmed on CT PA.

Pre-pathway implementation, mean LOS in ED and hospital for all-comers with suspected PE was 1277 minutes (21hrs 17mins). This compared with a mean LOS of 436 mins post pathway implementation (7 hrs 15 mins). This indicated a significant reduction in LOS post pathway implementation, $p<0.05$.

No adverse events were noted for patients placed on the ambulatory pathway. For those with negative CT PAs for PE (n=26), alternative diagnoses included atelectasis[5], infection[3] and benign pulmonary nodules[2]. The majority were reported as normal studies negative for PE. No clinically urgent pathology was identified, and all patients were discharged following a negative CT PA result.

Discussion

Traditionally, all patients with suspected PE required inpatient admission if their CTPA cannot be performed during on-call hours. This involves patients spending prolonged periods of time both in ED and in hospital. Recent BTS 2018 guidelines recommend ambulatory pathways for the diagnosis and management of “low risk” patients with PE in order to reduce hospital admission and length of stay, and also to improve care provided to patients[11].

This ambulatory pathway for patients with suspected PE was an ED led initiative, with close collaboration with the local Radiology, Haematology, and acute medical departments. This is an effective pathway which safely identifies the "low-risk" patient with suspected PE and offers an ambulatory approach to diagnosis for this patient group, thereby improving care and maximising resource efficiency. This pathway has succeeded in significantly decreasing length of stay both in the ED and in hospital, reducing inpatient bed requirement by 12 patients in April and 15 patients in May.

The use of length of stay in ED and hospital as a metric to display achievements of this pathway is a strong indicator of the success of this pathway. This is associated with reduced crowding and time spent in ED and in hospital, both of which have been shown to improve outcomes for ED all-comers, as well as the target population. In addition, this project has standardised care by providing an algorithm which can be followed to guide decision making.

The continued development of this project and the extension of outpatient services to enable "low-risk" patients with confirmed PE to be discharged from ED for rapid-access PE clinics would be a welcome initiative and may be implemented when resources and staffing are available to facilitate such clinics.

The trend towards the development and expansion of ambulatory pathways for a vast range of suitable conditions is of utmost importance to optimise the resources available to us in the health service, and to enable the provision of more patient-centred care, in the community, particularly pertinent given the current demand for acute hospital beds.

Declaration of Conflicts of Interest:
The above name authors have no conflicts of interest to declare.

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