Investigating for pulmonary embolism in pregnancy: Five year retrospective review of referrals to the acute medical unit of a large teaching hospital

EJ Hamilton, AQ Green, JA Cook & H Nash

Abstract

This was a retrospective review of five years' data relating to patients referred to the Acute Medical Unit (AMU) of a large teaching hospital with suspected Pulmonary Embolism (PE) during pregnancy or 6 weeks postpartum. During this period, 210 patients in this group underwent half-dose perfusion scanning as investigation for possible PE and were managed via our ambulatory pathway. Pulmonary embolism was diagnosed in 5.2% of patients compared to 18% of non-pregnant patients identified in a previous audit. Half-dose Q scanning enabled exclusion of PE in almost 90% of patients without the need for further imaging. A new local pathway for the investigation and management of PE during pregnancy has now been developed.

Keywords

Pregnancy, Pulmonary embolism, ambulatory, d-dimer, Ventilation/perfusion scanning.

Key Points

- The threshold for investigation for pulmonary embolism in pregnant and postpartum patients is lower than in the non-pregnant population.
- Scoring systems, such as modified Wells score, are not validated for use during pregnancy and appear generally unhelpful, along with DDimer measurements beyond the first trimester.
- Half-dose Q-scanning enables exclusion of pulmonary embolism without the need for further imaging in almost 90% of patients.

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Introduction

Norfolk and Norwich University Hospital (NNUH) is a busy teaching hospital situated on the outskirts of Norwich with a catchment area of 825,000. There is a purpose-built acute medical unit which has been running an ambulatory care pathway for investigation and management of pulmonary embolism since 2009 (Figure 1). In 2014 an audit was undertaken by Green *et al*[1] to assess adherence to this pathway. Data were gathered for all patients who underwent pulmonary imaging via the ambulatory PE pathway over a one-year period. This audit identified that 18% of patients who proceeded to pulmonary imaging were subsequently diagnosed with PE.

The local policy recommends that pregnant patients should be imaged using a half-dose perfusion scan to minimise radiation exposure to both mother and baby ('Half Q scan'), although patients with an abnormal chest x-ray usually undergo CTPA as a first-line investigation. Patients referred with possible DVT are seen using a separate nurse-led pathway. This service will not accept any patients who have possible concomitant DVT and PE, so all patients with suspected dual pathology will be seen by through the PE pathway.

In this study we aimed to review the investigation and management of those patients referred with suspected PE during pregnancy or 6 weeks post-partum, over a 5 year period from 2009 to 2014.

Method

The data set was collected by searching the IMPAX radiology database for all half Q scans performed from January 2009 to December 2014. Once this data set was collected additional patient data including age, pregnancy gestation, D-dimer and wells score was collected using a combination of the ICE blood and discharge system and patient notes.

Results

212 patients over a five year period received a half Q scan following the Pulmonary Embolism pathway. 2 patients were excluded from further analysis as they were more than six weeks postpartum. Therefore a total of 210 patient's data was available for further analysis.

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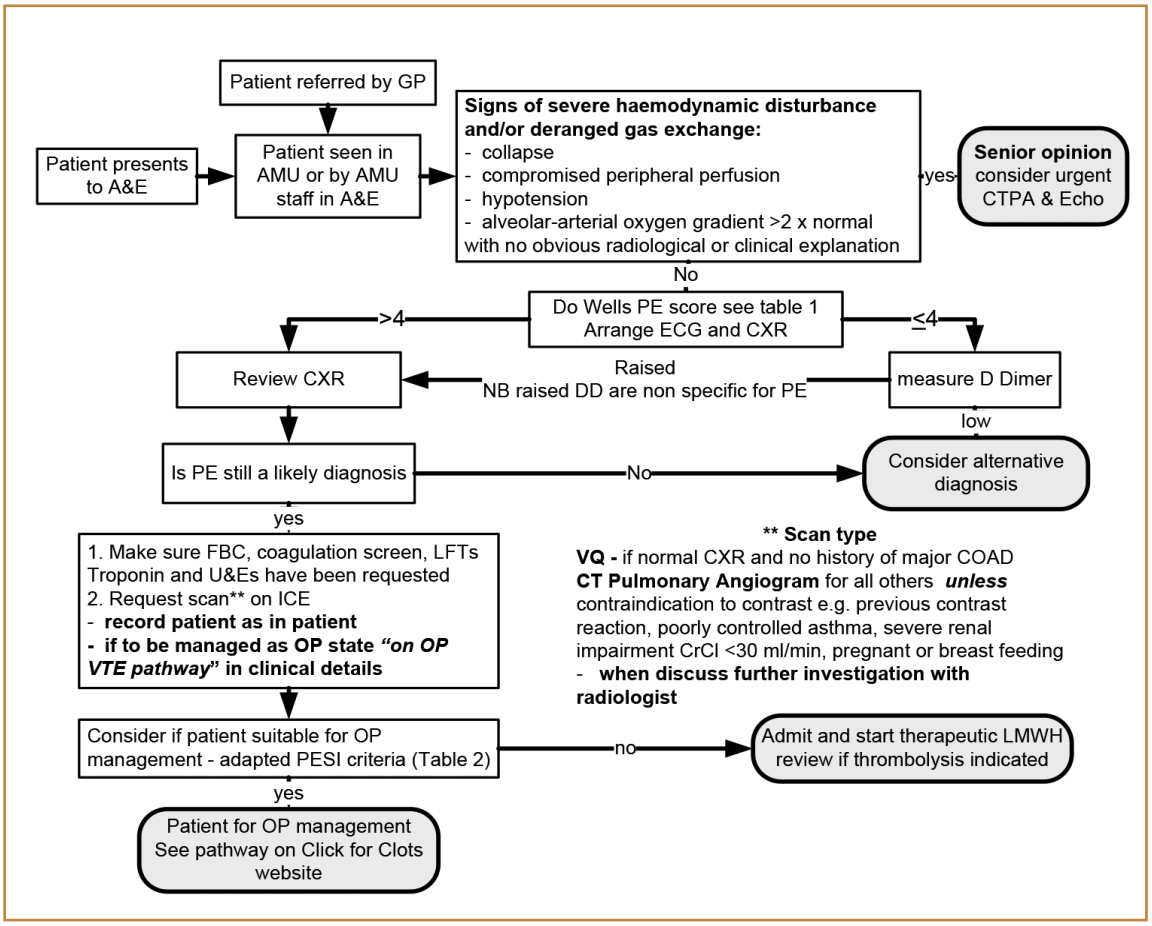


Figure 1. Algorithm for the management of suspected pulmonary embolism

PE was diagnosed in 21.4% (3/14) of patients in the first trimester, 2.9% (2/70) of patients in the second trimester, 4.4% (4/91) of patients in the third trimester and 5.4% (2/35) of patients in the post-partum period. The average age of the patients was 28.7 years (Range: 17-50 years).

A total of 5.2% (11/210) of patients were treated for PE. Lung perfusion was normal in 186 (88.6%) patients, enabling PE to be excluded without further investigation. Of the 24 remaining scans 5 were high probability (treated as positive) for PE and 19 were indeterminate. 13 patients proceeded to undergo CTPA, out of which 3 were positive and 10 were negative. Of the six patients who did not have further imaging, 3 were treated for a PE and 3 had a PE excluded on clinical grounds. Of these 3, none were re-admitted and none developed subsequent PE. One was treated as a lower respiratory tract infection, one as musculoskeletal pain and one as poorly controlled asthma (later diagnosed with bronchiectasis on HRCT). There were no maternal deaths from PE during our five-year review.

110 (52%) patients had two level modified-Wells score completed as part of their assessment. Of these patients, 33 were 'unlikely' (score 4 or less) and 77 'likely' (score >4). Three of the patients in the 'unlikely' group had positive scans (9%) while 4 patients in the 'likely' group had positive scans (5%). Two patients in the first trimester underwent d-dimer testing; in both cases the level was elevated and one of these patients was diagnosed with PE following indeterminate Half Q-Scan and positive CTPA.

Discussion

Although pregnancy and the postpartum period both incur an increased risk of pulmonary embolism.[2,3] the rates of PE in these groups are generally low (1 in 1000 to 1 in 3000 deliveries[2]). Recent meta-analysis would suggest that in the Emergency Department setting, among patients investigated for PE there is a lower incidence of VTE in the pregnant population than in non-pregnant women of childbearing age. This suggests that clinicians are inclined to test for PE at a lower threshold in the pregnant population.[4] Our review confirms this finding in an AMU / ambulatory care setting, with only 5.2% of patients undergoing half Q scans for possible PE in pregnancy or the postpartum period being diagnosed with PE; this compares to 18% of non-pregnant patients in

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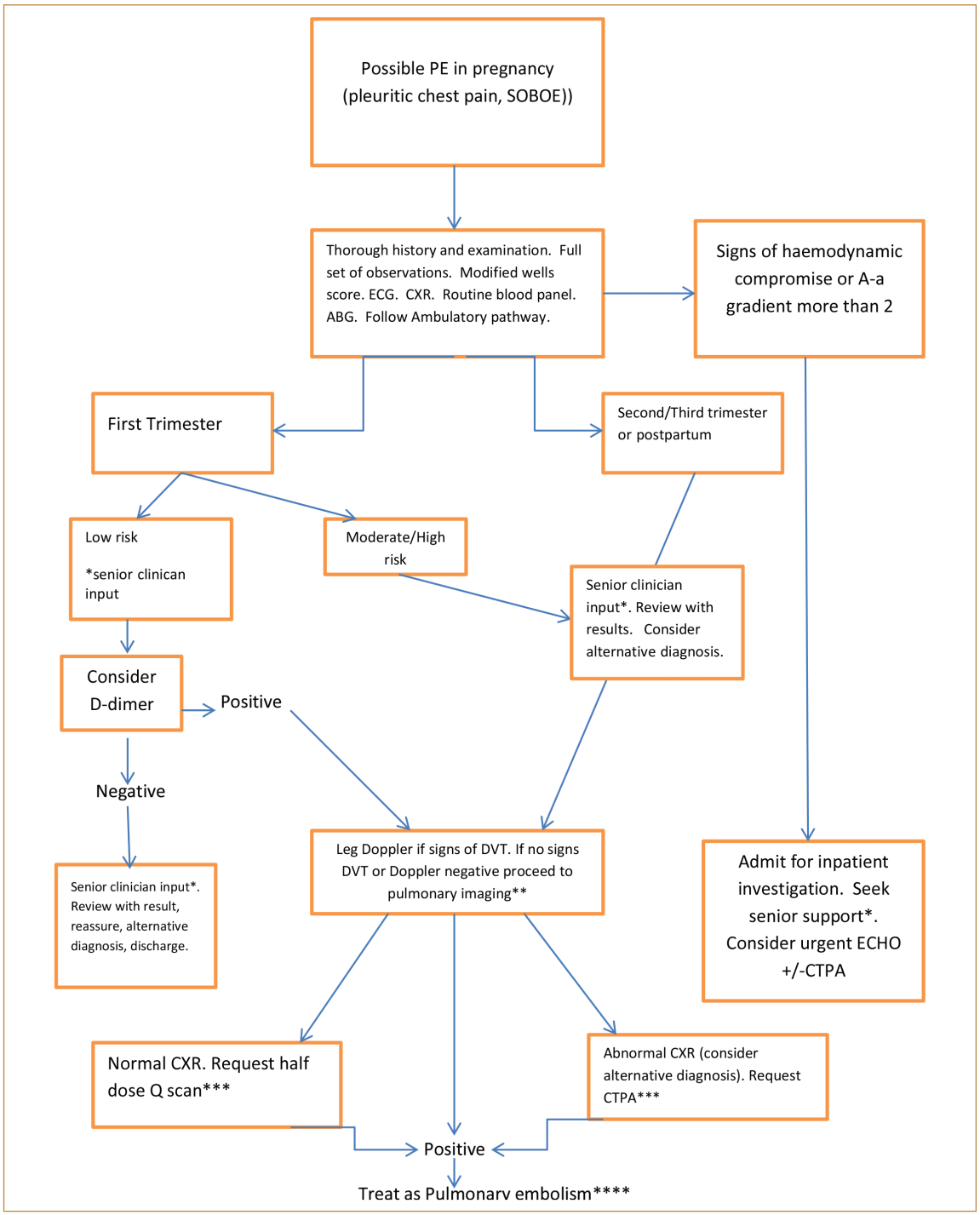


Figure 2. Revised local pathway for the investigation of patients with suspected PE during pregnancy

*Early involvement of senior clinician is beneficial. Some first trimester patients may have VTE excluded safely with use of d-dimer, risk scoring and clinical acumen but we do not recommend the routine measurement of d-dimer in pregnant or postpartum patients.

**Women with suspected PE should be advised that, compared with CTPA, V/Q scanning may carry a slightly increased risk of childhood cancer but is associated with a lower risk of maternal breast cancer; in both situations, the absolute risk is very small. Perfusion only half dose Q scans significantly reduce exposure compared with normal V/Q or CTPA.

***If unable to get scan same day then treat with LMWH and book in ambulatory scan slot for next day. Give PE advice sheet.

****Therapeutic anticoagulant therapy should be continued for the duration of the pregnancy and for at least 6 weeks postnatally and until at least 3 months of treatment has been given in total. Before discontinuing treatment the continuing risk of thrombosis should be assessed.

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our previous ambulatory care audit[1]. Our method of data gathering would have excluded a small group of pregnant patients who did not undergo half Q scanning and may have had Venous thromboembolic disease excluded (or diagnosed) by other means such as lower limb Doppler ultrasound, d-dimer testing, CTPA or on clinical grounds.

Half Q scans were able to exclude PE in almost 90% of patients without the need for further imaging. This is similar to previously published data.[5] Of those that were abnormal, a large proportion (19/24) were indeterminate, requiring consideration of CTPA. Further radiological exposure was avoided in 6 patients where half-Q scan was indeterminate, following clinical assessment. Three of these patients were treated as PE. The others were discharged with an alternative diagnosis with no subsequent admissions. This emphasises the importance of senior clinical review as part of the investigation pathway. These results were similar to those seen by Scarbrook at al where 92% of patients had a normal scan, 7% were indeterminate and 1% were high probability.[5]

Imaging for pulmonary embolism in pregnancy is generally considered safe. The radiation dose to the fetus is thought to be 0.1 mGy for a CTPA scan and 0.5mGy for a full dose VQ scan.[6, 7, 8] The International commission on Radiation Protection estimate the risk of childhood cancer before the age of 15 following in utero radiation exposure of 1 in 17 000 per mGy.[9] This suggests the risk of childhood cancer as a result of in utero exposure to a CTPA is around 1 in 170 000 and to a VQ is 1 in 34 000. These risks are both very small. Half dose Q scanning reduces the dose of radiation and the therefore the risk cancer further.[10]

Although radiation exposure to the fetus in CTPA compared to VQ scanning is low, the exposure to the patient's breast is very much higher. The radiation dose of VQ scans to the breast (0.98-1.07mGy) is very many times lower than CTPA scans (10-60mGy).[11] It has been suggested 10mGy radiation to the breast may lead to increase in background relative risk of breast cancer by 13.6 %.[11] However this should be interpreted in the context of the small absolute risk of breast cancer of around 0.1% for a 25 year old for the over the next 10 years. This means the absolute risk increase over the next 10 years is negligible (0.1% of 13.6% = 0. 0136% excess risk per 10mGy radiation).

Our review shows that only 1 in 20 patients who proceeded to half Q scans had a PE. Unfortunately, risk stratification for PE during pregnancy is challenging, and the modified Wells score is not validated in this patient group.[12] Our review confirms the unhelpfulness of the two-way modified Wells score in assessing pregnant patients for PE as 9% of the patients in the unlikely group had a PE compared to 5% in the likely group. Modified PERC scores have been proposed as an alternative to Wells during pregnancy[13] but as of yet this has not been validated and should not be used alone in the assessment of PE in pregnancy.

Our algorithm recommends DDimer testing only during the first trimester, as levels are invariably elevated after this time[14, 15] Only 2 patients in this cohort had undergone DDimer measurement, although our data collection method may have excluded some patients whose DDimer was negative and did not proceed to Half Q-scanning. The literature does suggest that a number of patients in the first trimester will have a normal D-dimer[16] and there is some evidence of the use of a modified cut off for subsequent trimesters and the post-partum period.[7,13,14,15] However, there is currently not enough evidence to support the use of increased cut-offs and this approach is not recommended by either the American Thoracic Society or the Royal College of Obstetrics and Gynaecology guidelines.[17, 18] A negative DDimer in the first trimester in the context of a low clinical suspicion may be helpful in avoiding unnecessary fetal radiation exposure; however careful, senior clinical evaluation is advised.

Our new local pathway (Figure 2) recommends half Q scanning as first line investigation but includes judicious use of modified wells scoring and D-dimer in the first trimester and the use of Doppler ultrasound in patients with leg symptoms. Further research into the use of a validated scoring system and/or modified D-dimer is required. We are currently preparing to commence a multi-centre prospective study into PE in pregnancy with the aim of producing a validated risk-scoring system.

Conflict of interest

Nothing to declare.

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