Hematol Oncol Stem Cell Ther (2016) 9, 131–136

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ORIGINAL RESEARCH REPORT

Yield of computed tomography pulmonary angiogram in the emergency department in cancer patients suspected to have pulmonary embolism

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Received 31 March 2016; accepted 13 August 2016
Available online 2 September 2016

KEYWORDS
Emergency service;
Hospital;
Neoplasm;
Pulmonary embolism;
Tomography;
X-ray computed

Abstract
Objective/background: The use of computed tomography pulmonary angiography (CTPA) in the emergency department (ED) for patients suspected to have pulmonary embolism (PE) has been steadily rising in the last 2 decades. However, there are limited studies that specifically address the use of CTPA in the ED for cancer patients suspected to have PE. The objective of this study is to assess the rate of positive PE by CTPA in the ED in cancer patients and the variables that are associated with positive results.
Methods: A retrospective review of electronic medical records for 208 consecutive patients with cancer who presented to the ED and received a CTPA for suspected PE over a 12-month period. The review included demographics, type and status of cancer, presenting symptoms, CTPA results, calculation of Wells Score, management based on CT findings, and outcome of patients.
Results: Among the 208 patients who met the inclusion criteria during our study period (mean age 57 ± 13.37 years, 73% women, 59% African American, and 32% Caucasians), 5.7% were diagnosed with PE. One hundred and eighty-two (83.7%) had a Wells Score $\leqslant$4, of which 2.2% were found to have to have PE, 22 (16.3%) patients had a Wells Score >4, of which 36.4% were found to have PE ($p < .0001$). Sensitivity and specificity of Wells >4 was 66.7% and 92.9%, respectively, with an odds ratio of 27 (95% CI 6.6–113.6). Receiver operator characteristics area under the

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http://dx.doi.org/10.1016/j.hemonc.2016.08.003

curve for Wells Score was 0.868. Age, race, sex, malignancy type, stage, status, clinical presentation, D-dimer, and a previous history of venous thromboembolism were not found to have statistically significant predictive values.
Conclusion: The yield of CTPA to rule out PE in patients with cancer presenting in the ED is low. Following a validated decision-making protocol such as Wells Criteria may significantly decrease the number of CTPA used in the ED.

Introduction

Cancer is a known risk factor for developing venous thromboembolism [1]. Population studies have shown that the incidence of venous thromboembolic disease in cancer patients ranges from 0.6% to 4.0% and is associated with an increased risk of mortality [2—7]. One of the fatal complications of venous thromboembolism is the development of pulmonary embolism (PE). Khorana et al. [3] reported that the mortality rates were 24.8% in cancer patients who developed PE compared with 6.5% of patients that did not have PE ($p < .0001$).

Early detection of PE and treatment with anticoagulation has been shown to improve survival [8]. Clinical decision rules, such as Wells Criteria, have been developed (and validated) to aid in ruling out patients that do not have PE [9]. However, the use of clinical decision rules to exclude those without PE is sporadically used [10]. There is ample evidence that the use of computed tomography pulmonary angiography (CTPA) in the emergency department (ED) for patients suspected to have PE has been steadily rising in the last 2 decades, which exposes patients to increased risks with no significant detection of PE or change in outcomes [11,12]. However, there are limited studies that specifically address the use of CTPA in the ED for cancer patients suspected to have PE. The aim of this study is to assess the rate of positive PE by CTPA in the ED in this patient population and the variables that are associated with positive results.

Methods

Study design and setting

This is a retrospective analysis of a cohort of 208 patients with a history of malignancy who presented to the ED of a tertiary academic hospital with a comprehensive cancer center and underwent CTPA to evaluate PE over 15 months. The study protocol was approved by the Institutional Review Board.

The inclusion criteria for the study were patients with a known history of malignancy and who had a CTPA to assess for PE in the ED. Patients excluded from the study were those who did not have a history of malignancy, those diagnosed with a malignancy post-CTPA, patients in whom the diagnosis of venous thromboembolism was only made with a ventilation—perfusion scan, and/or Doppler venous study. Patients that had insufficient data that would not allow calculation of a Wells Score were also excluded from the study.

Data collection and measurement

Patient demographics, presenting symptoms, documented physical exam, type of cancer including current stage (local, regional, distant, unstageable, unknown), disease status (remission, relapse, new diagnosis), and treatment were reviewed. Laboratory values, chest X-ray, and CTPA results were also recorded. Hospital course was also reviewed assessing for management of the patient, complications from CTPA, and disposition. D-dimer results when available were reviewed if they were obtained in the ED during initial workup.

Wells Score was retrospectively calculated for each patient from the collected data. While our population included only patients with a history of malignancy, patients whose disease was documented as in remission and who had been without chemotherapy for >6 months were not assigned 1 point for malignancy. Special consideration was given to clinician suspicion for PE being the primary diagnosis in Wells Score. Patients meeting the following criteria were assigned 3 points: (1) patients who were started on anticoagulation prior to the CTPA; (2) patients that were specifically sent to the ED for suspicion of PE; (3) documentation from the physician stating that PE was equally likely or most likely; (4) patients receiving ongoing anticoagulation at the time of admission were given 3 points; (5) patients with a history of deep vein thrombosis treated with Greenfield filter in lieu of anticoagulation were also designated to receive 3 points but we had no incidence of this in our study population. Patients that did not meet these criteria were not given any points for PE being the primary diagnosis in Wells Criteria.

The diagnosis of PE was confirmed by a pulmonary arterial filling defect on CTPA with pulmonary protocol. All CTPA with pulmonary protocol were reviewed by a board certified radiologist. The CTPA was also reviewed for an alternative diagnosis that may explain the patient's symptoms.

Complications from CTPA were assessed as contrast-induced nephropathy, extravasation of contrast material, and anaphylaxis from contrast material.

Data analysis

Continuous variables are presented with means and standard deviations. Categorical variables are summarized as percentages. To assess the differences between PE-positive and PE-negative patients in terms of Wells Criteria, Fischer's exact test was used with dichotomous value of