American Journal of
Oral Medicine and Radiology

ISSN - 2394-7721

www.mcmed.us/journal/ajomr

Research Article

LONG-TERM EVALUATION OF RADIATION EXPOSURE IN PULMONARY CT ANGIOGRAPHY FOR SUSPECTED PULMONARY EMBOLISMS: A RETROSPECTIVE STUDY

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ABSTRACT

An evaluation of the total exposure to radiation from pulmonary CT angiography for suspected pulmonary embolisms (PE) over the course of a was carried out in this study. We retrospectively reviewed 300 patients with suspected PE who presented to the emergency department and received pulmonary CTA scans. Our study evaluated patients' electronic medical records over the following four years to determine how much radiation exposure they received after CT scans. Based on DLP to E conversion coefficients, we calculated cumulative effective radiation doses. This is what we found. An analysis of 900 CT scans was conducted in this study. The cumulative medical radiation dose delivered to subjects over the course of a four-year study is estimated to be approximately 65%. There was only a 6.3% incidence of acute PEs in the radiology report. CTA in the lungs accounted for the majority of radiation doses associated with medical conditions over the last four years. Only a minority of subjects with acute PE will show positive findings on imaging, so clinically assessing pretest probability before imaging is imperative.

Keywords: Pulmonary CT Angiography, Radiation Exposure, Suspected Pulmonary Embolism, Retrospective Analysis

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Home page: **http://www.mcmed.us/journal/ajomr**		**Quick Response code**
Received:25.07.2023	**Revised**:10.08.2022	**Accepted**:14.08.2022

INTRODUCTION

Mortality and morbidity associated with pulmonary embolisms are high. About 100,000 Americans die every year as a result of PE in the United States [1]. A CT angiography (CTA), which is accessible, reliable, and noninvasive, Many studies have demonstrated that V/Q lung scanning and catheter pulmonary angiography aren't general diagnostic tools for PE. Due to a suspicion of PE, a CTA scan was ordered are, however, only rarely positive [1, 5–7]. Additionally, this test shows reduced specificity and sensitivity compared with previous reports [8] in the PIOPED II multicenter trial.

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The health risks associated with medical imaging increase over time as radiation dose accumulates. A number of factors can influence the potential risk of radiation injury from radiographic imaging, including the age and gender of the patient, and the fractionation of radiation used. In a CTA scan, approximately 10 mSv of radiation is delivered. Medical imaging has been implicated in several controversial studies. It has been estimated that 2,900 malignancies occur in the United States each year as a result of ionizing radiation from CT scans [10]. Among those who have lived with a lifetime exposure of 50 to 100 mSv, Brenner et al. found that cancer is virtually certain to occur with a lifetime exposure above 100 mSv. While there is debate over research findings like these, it is clear that using ionizing radiation to induce cancer poses a risk, however small. The cumulative effective radiation dose in patients after pulmonary CTA is currently unknown due to a lack of data. The effective radiation dose received following CTA and total effective radiation dose will be determined by a four-year follow-up of patients with suspected PE.

Materials and Methods

Choosing a cohort and designing the study. An urban health maintenance organization (HMO) hospital with 265 beds was the site of this retrospective cohort study. Health Insurance Portability and Accountability Act compliance was obtained for this study. Retrospective medical records reviews were conducted without informed consent. A record of estimated radiation dose was kept within the PACS system for CT studies since February 2006 and ended in November 2007. Our medical records tracked all effective radiation doses from CT for four years following the inclusion period.

Several hundred consecutive patients who underwent pulmonary CT scanning in the emergency department for suspected PE were followed up for four years after the CT scan. When subjects were 70 years and older at the time of the exam, they were excluded from the study before data collection began. Radiation exposure is less harmful as you age [10] due to a decrease in risk. Because older populations are less radiosensitive to cumulative radiation, It was our intention to exclude those over the age of 70. Following the PE study, additional subjects were excluded from the study after data collection if they had died within four years or did not have continuous health insurance coverage through the HMO. This would prevent the collection of comprehensive imaging data.

Data collection and analysis. In the present study, lung CT scans were conducted from 2 cm above the aortic arch to the diaphragm domes using a multislice CT unit (GE LightSpeed QX/i, General Electric Co., Milwaukee, WI, USA). Using 5 mm slices, 1.25 mm collimation, 120 kVp, 300 mA, and 1.5 pitch, slices of the apexes and bases of the lung were imaged before 1.5 cm slices were taken. Neither weight nor BMI was used as a criterion, but CT technologists could reduce the kVp (80 or 100) for thinner or smaller patients. A dose modulation process was also automated during the study period using GE. Omnipaque 300 (GE) was administered to subjects at a rate of 3mL/s.

During the study period, every patient undergoing pulmonary CTA provided their age, gender, radiation dose, and history of cancer. The Chi-square test was used for categorical variables and Student's t-test was used for continuous variables. It was considered statistically significant when the P 0.05 value was reached. Effective dose estimation method. Radiation exposure and patient cancer risk are taken into account when calculating effective dose from radiographic imagery. There are two methods available for calculating the effective radiation dose (E). The International Commission on Radiological Protection specifies tissue weighting factors when calculating doses in organs and tissues. Monte Carlo simulations and tissue weighting factors are used to provide dose estimates. Radiation dose index is estimated by summing radiation doses across individual organs. An improved model was also presented by Shrimpton and colleagues using simple conversion coefficients (k) derived from European multislice computed tomography guidelines. This model was chosen for this study because of its reasonable robustness and consistency when estimating the effective dose. In order to calculate radiation dose in anatomical regions, DLP was multiplied by k rather than calculated in individual organs. In CT studies that involved more than one anatomic region, we calculated radiation dose using the greatest k value.

RESULTS

Our study examined the medical records of 514 subjects who underwent CTA in the emergency department between February 2006 and November 2007 with suspected pulmonary embolism and were referred to the ED for suspected embolism. During pulmonary CTA, forty of the 514 subjects (7.8%) reported a positive PE. The CTA excluded 145 subjects due to not having maintained continuous health insurance coverage for at least 4 years after the CTA. A total of 69 patients died within four years of their CTA, resulting in their exclusion from the study.

According to the study, those who lost their insurance coverage (44.4% versus 50.7%) were significantly older than those who remained insured (44.4 versus 50.7, respectively). Female to male ratios did not differ significantly between those who lost insurance coverage and those included in this study (79 : 66 versus 189 : 111, respectively, P = 0.9). In Table 1, demographic data are presented for the original 514 subjects and 300 subjects covered for four years continuously.

In this 4-year study, 300 subjects underwent 900 CT exams, based on their original CTA examinations. In a cohort of 300 patients, the mean age was 50.7 years and the standard deviation was 13.4 years. Male and female subjects underwent 550 and 350 CT scans, respectively. There were 2.9 scans on average for women and 3.2 scans on average for men (P = 0.59). In Table 2, you will find anatomic distributions of CT scans. There was the most common scanning of chests, abdomens, and pelvises. Radiation doses over a four-year period were 31.1 x 40.5 mSv on average. One CT scan delivered a dose of 7.4 mSv, and 12 CT scans delivered a dose of 297.3 mSv. The average amount of power used in pulmonary computed tomography (CTA) was 10.7 x 2.5 mSv. According to CTA results, pulmonary CTA contributed about 65.3% to the total radiation dose over the course of four years. A CTA was performed for 129 subjects.

Table 1: Defining the subject's demographics

Age on average	50.2 ± 14.1 years
Typical age group	16–62 years old
Ratio of men to women	322/314
CTA pulmonary PE number	55 (7.9%)
Demographic data from 300-subject cohort	
Age on average	61.3 ± 16.7 years
Range of ages	16–57 years old
Ratio of males to females	110/165
Exposure to radiation cumulatively	31.2 ± 40.5 mSv
CTA pulmonary PE number	24 (6.3%)

Table 2: The initial CTA for PE evaluation was performed over the course of the 4-year period.

Anatomical region	Number of scans
Heading	164
In this area primarily	4
Throat	22
Chest and neck	2
Anatomy	468
Abdomen and chest	8
Continent	34
Ischial tube	5
Pelvis and abdomen	175
Pelvis, chest, and abdomen	18
As a whole	900

CT scans were performed only once over the past four years. Among the 4 patients who were correctly classified as having acute PE, or 3.1%, only 4 were correctly diagnosed. A number of CT scans and a dose of radiation were administered to subjects over a four-year period. Males received 32.6 mSv while females received 10.5 mSv, P = 0.65. Females received 32.6 and males received 30.3. A CTA revealed 19 acute PEs (6.3%) among the 300 subjects. By age group, there was an increase in CTA studies and positive PEs. Six CTA scans were performed on subjects aged 20 years or older, with one PE detected. CTA scans were performed on 128 subjects between the ages of 21 and 50, and five PEs were found in those scans. Last but not least, 14 pulmonary emboli were identified in 166 CTA scans performed on patients 51-70 years of age.

47 subjects (15.7%) received more than 50 mSv in total. The average CT scan per subject was 14 over four years. Fourteen of them received more than 100 millisieverts. The highest cumulative effective dose received by a subject was 164.3 mSv, resulting from 24 scans. Within four years of their PE study, 35 of the subjects had been diagnosed with cancer. A significant difference was observed between these subjects and those free of cancer (48.6 versus 28.4 mSv, respectively; P 0.01).

Among the 47 subjects in this study who were exposed to more than 50 mSv of radiation, 13 had been diagnosed with cancer before or after receiving the index pulmonary CTA. Comparing this population with people who have received more than 50 mSv of cumulative radiation dose (P = 0.03), the prevalence of cancer was significantly higher (P = 0.05).

DISCUSSION

Radiation exposure poses a number of health risks. Acute radiation doses between 10 and 50 mSv as well as long-term radiation doses between 50 and 100 mSv increase cancer risk [11]. CT scans typically account for a majority of medical imaging radiation dose indexes [13]. Numerous studies have investigated the cancer risk associated with pulmonary CTA. In one million people exposed to a single PET, 150 cancer deaths occur as a result of excess mortality, according to Cronin and coworkers [14]. One radiation-induced malignancy appears in every 330 females and 880 males who undergo CTA for suspected PE among 20-year-olds, according to Smith-Bindman [15]. Nanotechnology has advanced in recent years, leading to the development of new nanomaterials that may pose health and environmental risks [15]. Furthermore, some researchers are cultivating environmentally friendly methods of producing metal and metal oxide nanoparticles. As well, chemical processes, complex products, and synthetic processes must be reduced to minimize their negative effects. Utilizing biomaterials and utilizing nature's biological features can assist in achieving this goal through green methods. Plants have been used to make metal nanoparticles that are more efficient, cheaper, and nontoxic, according to a recent study. A better understanding of how biological entities produce metallic nanoparticles is needed in the process of synthesizing biological materials with green chemistry. Consistency in particle size will be one issue as well as reproducibility in the process. It is therefore necessary to further study the biological synthesis-dependent processes to evaluate and appreciate them. The green synthesis of metallic nanoparticles via living beings is currently an unexplored hot research area that requires further funding. Nanoparticle manufacturing and environmental applications are discussed in the study. It is becoming increasingly important in medicine to track cumulative radiation exposure. Inadvertent radiation exposures will be detected and identified with a systematic tracking and identification method for CT radiation exposure risks [27]. Shih et al. In the four years following their initial CTA review, 145 out of 514 subjects (28%) were still covered by the HMO. If future healthcare providers don't specifically request the radiographic imaging record of the patient, the history of radiation doses for the patient will be lost. Moreover, those who didn't maintain continuous health insurance were significantly younger. Because of their younger age, it may be difficult to evaluate Lifetime radiation exposure and its health risks.

As compared to subjects who were cancer-free at the time of their initial pulmonary CT scan, those who were diagnosed with malignancy received significantly more cumulative radiation. Radiation doses of more than 50 mSv were associated with a higher prevalence of cancer. It is reasonable to rationalize these results by considering how frequently cancer is diagnosed and managed using medical imaging.

CONCLUSION

The study discovered that, over the course of four years, 65.3% of the total CT radiation doses attributed to pulmonary CTA were positive for PE findings, while only 6.3% had negative PE results. Despite pulmonary CTA being a fast, widely available method for diagnosing PE, the study and literature indicate that more can be done to prevent potentially unnecessary imaging. In the ED, diagnostic protocols should be established, as the results of this study will hopefully emphasize.

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Cite this article:
Dr Abhijith Kumar, Dr Sahiti. Long-Term Evaluation of Radiation Exposure in Pulmonary CT Angiography for Suspected Pulmonary Embolisms: A Retrospective study. *American Journal of Oral Medicine and Radiology*, 2023, 10(2), 21-25.