Pulmonary CT Angiography for Pulmonary Embolism in Children at Two Adult-Centered Community Hospitals

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Purpose:

Pulmonary CT Angiography (CTA) to rule out pulmonary embolism (PE) is ordered relatively infrequently at pediatric hospitals. At these centers, pediatric radiologists and pediatric emergency physicians are educated regarding the risks of radiation exposure in children and adolescents, and the low incidence of pulmonary emboli in otherwise normal pediatric patients. Little has been reported regarding the use of pulmonary CTA in pediatric patients visiting adult-centered hospitals, where CT utilization and radiation doses may be higher than at pediatric centers.

Objectives:

• Assess the percent of positive chest CTA studies in pediatric patients evaluated for PE at two adult-centered community hospitals.
• Evaluate the use of chest radiography and D-dimer studies in patients undergoing chest CTA.
• Compare CTA doses in our patients to those reported in the literature.

Methods:

An IRB-approved retrospective analysis of medical records was conducted at two separate adult-centered community hospitals in a small city in the midwestern United States. Patients aged 0-19 who underwent pulmonary CTA during a one-year period (2007) were identified. Clinical presentation and test results were extracted. CTA radiation doses on a representative sample of pediatric patients at these institutions were calculated using the total dose-length product reported on the scanner dose reports.

Key Findings:

Number of pediatric patients studied: 83
Age range: 14-19 years
Gender: 82% female
Location: 84% ER, 11% outpatient, 5% inpatient
Percent positive for PE: Zero
Percent screened with D-dimer before CTA: 37%
Percent examined with chest radiography before CTA: 57%

Of the 47 patients who underwent chest radiography before CTA, the CT study added clinically important information in only two.*

Risk Factors and Study Adequacy:

• Risk factors for DVT/PE in our patients included oral contraceptive use (11 patients), pregnancy (11), recently post-partum (5), prior PE or DVT (3), hypercoagulable blood disorder (3), Crohn disease (2), and long road trips (2).
• Chest CTA was ordered in two patients with a normal D-dimer.
• One CTA study was labeled “nondiagnostic” and 14 “suboptimal”.

Radiation and Pulmonary CTA:

• Radiation doses ranged from 6.5 to 10.3 mSv, averaging 7.9 mSv. The literature reports lower typical doses in pediatric chest CT (around 3 mSv).3
• Pediatric dose protocols were infrequently utilized. Dose reports were rarely saved in the permanent PACS file.
• One chest CTA at our institutions equals the equivalent radiation dose of a lifetime (61 years) of screening mammography exams.3,4
• The risk of fatal radiation-induced cancer has been estimated to be as high as 1 per 1000 CT studies.2
• Relative risk of cancer is highest in female patients, due to breast irradiation, and in very young children.5

Conclusions:

• Zero percent diagnostic yield of CTA for PE over a one year period highlights the relative infrequent incidence of PE in adolescents and raises the question of CTA overutilization in the pediatric population at these institutions.
• Some of these studies might have been avoided with judicious evaluation of risk factors, as well as rigorous use of D-dimer screening and chest radiography, which appear to be underutilized in this setting.
• Pregnancy and oral contraceptive use play a dominant role in the decision to order pulmonary CTA in adolescents.
• Pediatric dose protocols have not become incorporated into routine CTA use in these adult-centered hospitals.
• Education regarding the frequency of pediatric PE and radiation safety must extend from Pediatric Radiology and Pediatric Emergency Medicine into adult-centered medical practices.

15-year-old patient complaining of left-sided chest pain and mild shortness of breath after visiting an amusement park. Pulmonary CTA was performed before chest radiography and D-dimer screening. Note the small pneumothorax and also the high mA value. The study was negative for pulmonary embolism.

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Footnotes:

* Aortic root ectasia and bilateral pleural effusions in one patient, trace pneumomediastinum in the other.