Follow-up of Incidental Pulmonary Nodules and the Radiology Report

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Abstract

Purpose: Incidental pulmonary nodules that require follow-up are often noted on chest CT. Evidence-based guidelines regarding appropriate follow-up have been published, but the rate of adherence to guideline recommendations is unknown. Furthermore, it is unknown whether the radiology report affects the nodule follow-up rate.

Methods: A review of 1,000 CT pulmonary angiographic studies ordered in the emergency department was performed to determine the presence of an incidental pulmonary nodule. Fleischner Society guidelines were applied to ascertain if follow-up was recommended. Radiology reports were classified on the basis of whether nodules were listed in the findings section only, were noted in the impression section, or had explicit recommendations for follow-up. Whether the rate of nodule follow-up was affected by the radiology report was determined according to these 3 groups.

Results: Incidental pulmonary nodules that required follow-up were noted on 9.9% (95% confidence interval, 8%−12%) of CT pulmonary angiographic studies. Follow-up for nodules was poor overall (29% [28 of 96]; 95% confidence interval, 20%−38%) and decreased significantly when the nodules were mentioned in the findings section only (0% [0 of 12]). Specific instructions to follow up nodules in radiology reports still resulted in a low follow-up rate of 29% (19 of 65; 95% confidence interval, 18%−40%).

Conclusions: Incidental pulmonary nodules detected on CT pulmonary angiography are common and are frequently not followed up appropriately. Although the inclusion of a pulmonary nodule in the impression section of a radiology report is helpful, it does not ensure follow-up. Better systems for appropriate identification and follow-up of incidental findings are needed.

Key Words: CT chest, CT pulmonary angiography, incidental pulmonary nodule, follow-up, Fleischner society guidelines

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BACKGROUND

CT pulmonary angiography is ordered frequently in emergency departments (EDs) to evaluate clinically suspected pulmonary embolus [1]. However, incidental pulmonary nodules that require follow-up are often noted on these examinations [2]. The most widely accepted, evidence-based guidelines for follow-up of incidentally noted pulmonary nodules are the Fleischner Society guidelines [3]. These guidelines use pretest probability of malignancy (on the basis of nodule size, patient age, and presence of smoking history or other risk factors) to determine schedules and duration for radiographic follow-up of incidentally noted subcentimeter pulmonary nodules. Fleischner Society guidelines recommend follow-up CT of the chest at various intervals for pulmonary nodules >4 mm in size in nonsmokers or patients who are otherwise deemed "low risk" and follow-up CT of the chest for nodules of any size in smokers or "high-risk" patients [3].

Adherence to evidence-based guidelines for the follow-up of pulmonary nodules is important to evaluate the possibility of malignancy. Although studies [4,5] have shown significant variation in radiologists' adherence to guidelines when making follow-up recommendations, adherence to Fleischner Society guidelines in patient follow-up remains unknown.

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Radiology reports differ on how frequently they include follow-up recommendations based, in part, on radiology subspecialty; for example, chest radiologists recommend incidental pulmonary nodule follow-up more often than ED radiologists [6]. However, whether pulmonary nodule reporting within the radiology report affects the follow-up rate is unknown. Here we report follow-up adherence to Fleischner Society guidelines for incidental pulmonary nodules on CT pulmonary angiography and whether, and how, the radiology reports of general radiologists affect follow-up.

METHODS

A waiver of the requirement for individual written informed consent was received from the institutional review board of Intermountain Healthcare. We identified 3,500 consecutive CT pulmonary angiographic examinations ordered in the EDs of LDS Hospital and Intermountain Medical Center for suspicion of pulmonary embolus between May 2009 and June 2010 and reported on adherence to Prospective Investigation of Pulmonary Embolism Diagnosis II guidelines in ordering these studies in the ED [7]. At the time of the study, no formal radiology department guidelines regarding pulmonary nodule reporting existed. However, all radiologists in the practice were aware of Fleischner Society guidelines, and macros containing pulmonary nodule follow-up recommendations were available in the reporting system for use. A group of 67 general radiologists and radiologists of varying specialties interpret CT pulmonary angiograms obtained at the Intermountain Medical Center and LDS Hospital EDs. Only 4 of the 67 are chest radiologists, and all 67 radiologists read ED studies according to their clinical call schedules.

Our PACS is manufactured by AGFA (http://www.agfa.com). CT pulmonary angiograms were obtained using either a Toshiba Aquilion 64 scanner with helical pitch of 0.9 at 0.5-mm slice thickness or a GE LightSpeed 64 scanner with helical pitch of 1.375 at 0.6-mm slice thickness. Eighty milliliters of iopamidol (Isovue 370; Bracco Imaging SpA, Milan, Italy) contrast was injected intravenously at 5 cm^3/s, and patients were scanned at 120 kV with automated tube current dose modulation. Images were reconstructed in the axial plane in 2-mm slices with 1-mm overlap, as well as 3 × 3 mm coronal and sagittal reformats. Coronal 10 × 2 mm maximum-intensity projections were also reviewed.

To determine the rate of incidental pulmonary nodules in this patient population, we identified 2,797 CT pulmonary angiograms obtained in patients aged ≥35 years, to whom the Fleischer Society guidelines apply. Multiple scans for the same patient were removed, resulting in 2,562 unique patients. A random sample of 1,000 patients was selected for manual chart review (D.P.B.), and a standardized questionnaire was used to extract information pertaining to 3 questions: (1) What is the rate of incidentally noted pulmonary nodules that require follow-up? (2) What is the rate of appropriate follow-up when an incidentally noted pulmonary nodule is reported on a CT pulmonary angiographic examination ordered in the ED? and (3) Does the radiology report affect the rate of appropriate pulmonary nodule follow-up?

What Is the Rate of Incidentally Noted Pulmonary Nodules That Require Follow-up?

We were interested in assessing the rate of pulmonary nodules that require follow-up, rather than the rate of incidental pulmonary nodules in general. Therefore, in our assessment of an identified pulmonary nodule on CT pulmonary angiography, we tried to account for studies or patient or nodule factors that would have indicated to a provider that follow-up was not indicated for this finding. Thus, our assessment of pulmonary nodules was focused on identifying how often pulmonary nodules that ought to have follow-up were followed, rather than how often any identified pulmonary nodule was followed.

Review of CT pulmonary angiographic reports was performed to determine the presence of an incidentally noted, noncalcified pulmonary nodule, and the Fleischner Society guidelines were applied to ascertain if follow-up was recommended. If the radiology report explicitly stated that the nodule did not require follow-up (eg, because of comparison with prior imaging or characteristics consistent with prior granulomatous disease), we assumed that no follow-up was necessary. If no such statement was made, we reviewed the electronic medical record (EMR) (Help2; Intermountain Healthcare, Salt Lake City, Utah) for prior CT scans of the chest. If there was a CT scan of the chest ≥2 years previously and the nodule was unchanged in size, either according to the stated size in the reports or by manual review of the images, we concluded that the nodule did not require follow-up according to Fleischner Society guidelines.

The indication for and interval of follow-up were determined according to the Fleischner Society guidelines [3] by evaluating the nodule size and patient risk factors identified via EMR review. The size of a nodule was recorded from the radiology report. In the case of a CT scan demonstrating multiple nodules, the largest nodule was used to determine recommendations for