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Radiologists' Recommendations for Additional Imaging on Inpatient CT Studies: Do Referring Physicians Follow Them?

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Abstract

Objectives: Studies have found that recommendations for additional imaging (RAI) accompany up to 31% of index computed tomography (CT) scans. In this study we assessed the frequency with which recommendations are accepted by the referring physician and the impact of AI on case management.

Methods: We performed a cross-sectional study of all index CT scans of the chest, abdomen, and pelvis performed on adult inpatients during a 1-month period at a tertiary medical center. Each radiology report was examined for mention of RAI. We used a standardized abstraction tool to review medical records for the indication for the RAI (related to original diagnosis vs incidental finding), the clinician's rationale for pursuing or discarding the RAI, and the impact of the AI on the inpatient treatment plan.

Results: Among the 430 scans reviewed, most (57.7%) were of the abdomen/pelvis. RAI was recommended in 67 cases (odds ratio [OR] 15.6%; 95% confidence interval [CI] 12.4–19.3) and AI was completed in 24 of 67 cases (35.8%). Factors associated with a recommendation for AI were the presence of an incidental finding (OR 3.5, 95% CI 1.7–6.8) and verbal communication of the result to the ordering provider (OR 2.09, 95% CI 1.23–3.5). When performed, AI altered the treatment plan 75% (18/24) of the time. Among the 43 cases in which AI was not performed, 34.1% were deferred to outpatient, 13.6% underwent alternative clinical intervention, and 13.6% were judged unnecessary by the primary team. No rationale was documented in the chart for the remaining 38.6%.

Conclusions: Despite concerns about autoreferral by radiologists for AI studies, we found a lower rate than in many prior studies, which may reflect a change in clinical practice. One-third of these recommendations were implemented and verbal communication was strongly associated with the likelihood of second image ordering. In the majority of the cases, the AI affected patient management. Based on these findings, radiologists should consider calling the ordering provider to increase the likelihood that the primary team will follow their recommendations.

Keywords

additional imaging; computed tomography; radiologist recommendations

Technological advancements in computed tomography (CT) scanning have increased its clinical utility. At the same time, the rise of defensive medicine, coupled with increasing ownership interest of CT centers by referral physicians (self-referral), has led to a dramatic growth in the use of CT.^{1–4} After a continuous increase in the utilization of noninvasive diagnosis imaging in the previous decade, however, one study found that there has been a decrease in the growth rate of CT scanning in the period 2005–2008 as compared with 1998–2005.⁵

In their interpretive reports, radiologists may recommend further imaging to clarify an indeterminate finding on the index scan.^{6,7} There is a common perception among nonradiologist clinicians that radiologists recommend further imaging without carefully reviewing a patient's clinical circumstances.⁸ Prior studies have shown that between 20% and 31% of CT scans result in a recommendation for additional imaging (RAI).^{9–12} Most of these studies were conducted before 2000⁹ or examined only imaging studies performed in outpatient or emergency departments.¹⁰

In this study we sought to describe the frequency of RAI following an index CT scan. We also assessed the rate of acceptance of recommendations by the primary team and whether the AI influenced clinical management.

Methods

Design, Setting, and Subjects

We performed a cross-sectional study at one urban tertiary care teaching hospital, Baystate Medical Center, with 720 beds in western Massachusetts. We included all patients 18 years old and older with an index CT scan of the chest, abdomen, or pelvis with or without contrast performed during their hospitalization from December 1, 2010 to December 31, 2010. A CT study was considered an index study if the subject did not have a similar imaging modality within 4 weeks of the scan under study. During the study period, there were 12 attending radiologists and 15 radiology residents in our institution. All of the reports read initially by a resident were confirmed by a senior radiologist. We did not collect data on the radiologists' years in practice.

Assessment Algorithm of the CT Scans

We reviewed all of the eligible CT scan reports for documentation of RAI and documentation of AI in the same hospitalization. We noted the principal indication for the scan and whether the recommendation for AI was communicated verbally to the ordering team. We also noted whether AI changed the diagnosis, treatment plan, or both. If the RAI was not followed, then we reviewed the progress notes and discharge summary to determine whether the clinician explained the reason for not complying with the recommendation. We noted presence of incidental findings, defined as a radiologist's comment on an abnormal

finding that did not pertain to the clinical query or likely pathology in question. Chart abstraction form is available upon request from the authors.

The radiology report and patient chart were abstracted by three investigators (O.H., T.S., and J.F.). A standardized data collection tool and the chart review process were pilot tested until there was perfect agreement among all abstractors. This entailed a review of approximately 15% of the total patient charts before the formal data collection period began.

Statistical Analysis

All of the outcomes are reported descriptively using means $\pm$ standard deviations or n (%), with 95% confidence intervals (CIs) for proportions. The associations between baseline characteristics and recommendation for follow-up imaging were tested using the Fisher exact (categorical) or unpaired *t* tests (means). Multivariable logistic regression was used to identify independent correlates of RAI. In addition, we analyzed whether the verbal communication of the findings influenced the order of a second imaging. We also assessed whether a diagnosis of malignancy was associated with the decision for recommendation for follow-up and for the ordering of the imaging. A patient was coded as having possible underlying malignancy if his or her scan indication included tumor, pulmonary nodule, lung cancer, or mass/tumor. The critical significance level was set at 0.05 for all comparisons, and STATA 14.1 (StataCorp, College Station, TX) was used for all of the analyses. The study was approved by Baystate Medical Center's institutional review board.

Results

A total of 430 index CT scans of the chest, abdomen, and pelvis were evaluated and more than half (57.7%) were abdomen/pelvis CTs. The mean $\pm$ standard deviation patient age was 61.9 ± 18.3 years and 49.3% of the patients were men.

In 273 (63.5%) of the reports, an incidental finding was noted by radiologists, and in 8.4% ($n = 36$) a stable, previously documented, incidental finding was reported. Radiologists recommended AI studies in 67 of 430 cases (15.6%, 95% confidence interval [CI] 12.4–19.3). Among the 237 radiology reports in which a new incidental finding was noted, 56 (23.7%) were referred for follow-up study.

As shown in the Table, RAI was not associated with age, sex, or scan type. Cases with an incidental finding on index scan were 3.5 times more likely (odds ratio [OR] 3.5, 95% CI 1.76–6.83) than those without an incidental finding on index scan to receive a recommendation for AI studies.

AI was performed in 24 of 67 (35.8%) RAI cases (Fig. 1), or 5.6% (95% CI 3.8–8.2) of the overall sample. In 197 reports (45.8%, 95% CI 41.1–50.6), the results were called by the radiologist to the ordering team. Second orders occurred 20.8% (41 of 197 cases) of the time when the provider was called compared with 11.2% (26 of 233 cases) of the time when the provider was not called (OR 2.09, 95% CI 1.23–3.5). There were 28 patients with an indication of underlying malignancy (6.5%, 95% CI 4.5–9.3). Second orders occurred 17.9% (5 of 28 cases) of the time when possible malignancy was indicated compared with 15.4%

(62 of 402 cases) of the time when malignancy was not indicated (OR 1.19, 95% CI 0.44–3.25).

AI altered treatment 75% (18 of 24 cases) of the time: in 5 (20.8%) cases, a questionable diagnosis was confirmed and the treatment plan was altered accordingly; in 3 (12.5%) cases, an alternative pathology was identified; and in 10 (41.7%) cases, AI was performed for diagnostic/therapeutic purposes. In 6 cases (25.0%), known diagnoses were confirmed resulting in no change to the treatment plan (Fig. 2).

When AI was not performed during hospitalization (44 cases), the most frequently documented reason was referral to an outpatient setting (15 of 44 cases, 34.1%). In 6 of 44 (13.6%) cases, the primary team concluded that additional studies were not indicated, and in another 13.6%, the referring physician decided to use an alternative diagnostic modality. In more than one-third of the cases (38.6%), there was no documentation in the medical record as to why follow-up imaging was not performed (Fig. 3).

Discussion

In this detailed retrospective medical record review of >400 CT scans of the chest, abdomen, and pelvis performed at Baystate Medical Center, a large tertiary care center, we found that radiologists recommended follow-up studies in a small proportion of index scans (16%), and that these recommendations were followed in one-third of the cases. The primary provider was twice as likely to order follow-up imaging if the result was verbally communicated by the radiologist. When the recommendation was followed up by the referral physician, patient care was affected in 75% of the cases. These data suggest that the primary team is judicious in its decision to comply with the recommendations and does take into account other clinical factors.

Approximately 70 million scans are performed annually in the United States.¹³ There has been a marked increase in the number of CT scans performed and a simultaneous rise in the number of follow-up imaging recommendations by radiologists in their interpretive reports.^{6,7,9–11} A study by Sistrom et al¹² that reviewed 5.9 million diagnostic imaging investigations performed between 1995 and 2008 at a single institution found an RAI rate of 21.4%; the odds of an examination resulting in an RAI doubled during the study period.

Although radiologists cannot directly order another imaging study, they can influence the decision of the referring physician through their suggestions made in the radiological report.^{14,15} Our study takes an important step in examining the outcomes of radiologists' recommendations for AI studies after a CT scan in hospitalized patients. Although most of the prior studies cite follow-up imaging recommendations in the range of 20% to 30% of index CT scans,^{9,10,12} we found a lower rate of 16%. This result may reflect a changing trend within the practice of radiology based on increased awareness of appropriateness criteria, the risk of radiation, and additional cost.

Our results are close to those reported by a study performed in 1993 that assessed the outcome of self-referral from radiologists' examinations after interpreting CT scans of the abdomen ordered in outpatient settings.⁹ The rates of recommendations for follow-up in this

study were 19.3%, compared with 15.5% in our study; in both studies, radiologists' recommendations were followed in one-third of the cases. In our study, when follow-up imaging was performed during hospitalization, the most common reason cited by ordering clinicians was for therapeutic, diagnostic, or both purposes. One-third of the time, the follow-up imaging affected patient management either through the clarification of a preexisting finding or via a new diagnosis. We found that verbal communication of the recommendation for AI was strongly associated with the willingness of the ordering team to perform the second imaging study. This is of practical importance, supporting the notion that direct communication among providers can clarify the reasons for specific recommendations.

Most RAIs that did not result in an AI during the index hospitalization were deferred to outpatient care services by in-hospital clinicians, likely for the follow-up of an incidental finding. We do not know whether these studies were performed eventually or how the results were communicated to primary care physicians. It may be reasonable to assume that follow-up studies were performed, which would increase the rate of AI performed to 58%.

We attempted to examine factors influencing a physician's decision to pursue or forgo follow-up imaging by assessing documentation in the medical record. Frequently, there was either insufficient documentation outlining the clinical reasoning behind such decisions or the result of the study was not acknowledged at all; this practice raises serious concerns. The communication among clinicians caring for patients both within the hospital setting and during the transition to outpatient care is mainly based on the information included in the medical record. Lack of proper documentation regarding the imaging study can impair timely follow-up, which in turn may contribute to medical errors. Although verbal communication is ideal and is associated with increased appropriate follow-up, it is not always possible and the electronic medical record remains the main tool of communication.

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The major strengths of our study include thorough chart review using a validated abstraction form with high interrater agreement and detailed assessment of the reasons physicians decided to pursue AI. Our study has several limitations as well. First, it was conducted at a single tertiary care hospital, so our results may not be generalizable to other hospitals. We did not collect information about the radiologists' years in practice. Although experience is important for predicting RAI, we do not believe it would influence the decision of the primary team to order follow-up imaging. Second, the short timeframe of the data collection period could preclude the observation of changes in radiologic practice based on seasonal or hospital-flow variations; however, there are no obvious reasons that radiology practice would change seasonally. Third, we used 4 weeks as a cutoff for a scan being an index scan. For more chronic problems, a longer cutoff may have been more appropriate. Fourth, the medical record was used as a proxy for clinical reasoning to determine why clinician teams did or did not follow up on imaging recommendations. The medical record should be a method for communicating decision making, however, and is an integral part of clinician-to-clinician communication. Finally, we assessed follow-up during the hospitalization and not in the outpatient setting; therefore, the rate of follow-up imaging we observed is likely underestimated.

To decrease unnecessary testing and minimize the risk of failure to follow significant findings, it is extremely important to reveal the reasons behind a clinician's determination of the appropriateness of a recommendation for further testing. Our study supports the recommendations of a prior study, that a better approach may be a consultation between the referring physician and the radiologist about the findings, especially when a second imaging study is suggested.⁹

Conclusions

Despite concerns about autoreferral by radiologists for AI studies, we found a lower rate than in many previous studies, which may reflect a change in clinical practice. Only one-third of these recommendations were implemented, and verbal communication was strongly associated with the likelihood of second image ordering. In most of the cases, the AI affected patient management. Frequently, documentation by the primary team within the medical record was poor and did not describe the reasoning behind the decision not to pursue further imaging. Based on these findings, radiologists should consider calling the ordering provider when their recommendation for follow up is imperative for patient outcomes.

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Key Points

- Despite concerns about autoreferral by radiologists for additional imaging studies, we found a lower rate than in many prior studies, which may reflect a change in clinical practice.
- Only one-third of these recommendations were implemented, but in most cases the additional imaging affected patient management.
- Frequently documentation by the primary team within the medical record was poor and did not describe the reasoning behind the decision not to pursue further imaging.
- Verbal communication of the recommendation for additional imaging was strongly associated with the willingness of the ordering team to perform the second imaging study.

Fig. 1.
Number (%) of index CT scans and subsequent follow-up recommended by radiology and clinician adherence to follow-up recommendation. CT, computed tomography.

Fig. 2.
Impact of follow-up imaging.

Fig. 3.
Reasons that follow-up imaging was not performed. TX, treatment.

Table.

RAI according to baseline characteristics

	Follow-up recommended, mean $\pm$ SD or n (%)			
	Yes, n = 67	No, n = 363	OR (95% CI)*	P*
Age, y	62 $\pm$ 13	61 $\pm$ 20	1.00 (0.99–1.02)	0.86
Male sex	27 (40.3)	185 (51.0)	0.65 (0.38–1.10)	0.11
Type of index scan				
Abdomen	41 (61.2)	207 (57.0)	1.00 (<i>ref</i>)	
Chest	26 (38.8)	156 (43.0)	0.84 (0.49–1.44)	0.53
Incidental findings on index scan	56 (83.6)	217 (59.8)	3.50 (1.76–6.83)	<0.001

CI, confidence interval; OR, odds ratio; RAI, recommendation for additional imaging; SD, standard deviation.