Incidental Findings in Radiographic Imaging for Inpatients with Acute Ischemic Stroke

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Background: Incidental findings on radiographic diagnostic imaging are a growing concern in the medical field. Little is known about the incidence and spectrum of incidental findings uncovered during stroke evaluations. *Methods and Results:* A random sample of 200 acute ischemic stroke admissions at an academic medical center was reviewed to better understand the incidence and spectrum of incidental findings on radiographic imaging studies obtained for a stroke evaluation. Among 200 stroke patients, 53 (26.5%) were found to have one or more incidental findings on radiographic imaging. Over 651 imaging studies, 69 incidental findings were uncovered, or 11 incidental findings per 100 imaging studies. Incidental findings were most commonly discovered within computerized tomography angiograms of the head and neck ($n = 41$ from of 176 studies). The most commonly identified incidental findings included thyroid nodules ($n = 12$), sinus disease ($n = 11$), pulmonary nodules ($n = 10$), and intracranial/cervical artery aneurysms ($n = 5$). *Conclusions:* Incidental findings are commonly found in patients undergoing an evaluation for acute ischemic stroke, some of which may be clinically relevant. Vascular neurologists and other clinicians caring for stroke patients may benefit from guidance on the management of expected incidental findings.

Key Words: Stroke—ischemic stroke—imaging—incidental findings—computerized tomography—magnetic resonance imaging

Introduction

Improvements in imaging technology have made medical imaging a central pillar of diagnosis and treatment for acute ischemic stroke. However, frequent and increasing use of radiographic studies in diagnostic stroke evaluations has the potential to uncover significant incidental findings.[1] Incidental findings are defined as any abnormality not related to the illness or causes that prompted the diagnostic imaging test.[2] Previous studies found that angiography of the chest for the diagnosis of pulmonary embolism was twice as likely to identify an incidental pulmonary nodule or adenopathy than pulmonary embolism.[3] How clinicians address these findings is of growing concern in many fields of medicine and surgery.[4]

For ischemic stroke, the standard workup to confirm the diagnosis and elucidate the etiology depends heavily on radiographic imaging. A standard workup can include computerized tomography (CT) and/or magnetic resonance (MR) image of the head, CT/MR angiography of the head and neck or carotid ultrasonography, and echocardiography. Based on results from these studies as well

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as the patient's age and comorbidities, further imaging studies may be pursued in search of the most likely stroke mechanism. Given this, there are ample opportunities to uncover incidental findings. The incidence and spectrum of incidental findings identified throughout a stroke work up is unknown. Describing the frequency and characteristics of these incidental findings may better guide neurologists and physicians of all specialties in the management and care of stroke patients.

Therefore, we sought to identify the frequency of incidental findings on radiographic imaging studies among patients undergoing an inpatient stroke evaluation, and characterize the spectrum of these incidental imaging results.

Methods

We conducted a retrospective observational study of stroke patients at the primary teaching hospital (Strong Memorial Hospital) of an academic medical center (University of Rochester Medical Center) with the goal of quantifying and characterizing incidental radiographic imaging findings uncovered during a stroke diagnostic work up. Strong Memorial Hospital is an 830-bed facility serving over 1,200 stroke patients annually, currently designated a Comprehensive Stroke Center by the Joint Commission and an active participant in the Get With the Guidelines national quality improvement program. The University of Rochester Research Subjects Review Board approved the study with a waiver of informed consent.

Patient Selection

Using the hospital's Get With the Guidelines database, 822 patients discharged with an acute ischemic stroke (using International Classification of Diseases – *Ninth Revision* codes 433.X1, 434.X1) between July 1, 2015 and June 30, 2016, were identified. From this overall sample, 200 patients were selected at random for this study. This sample size ensures a margin of error of no greater than 5% assuming the frequency of incidental findings reported from prior literature.[2] Adult stroke patients (age ≥18 years) were included in the study. Patient characteristics such as age, sex, comorbidities, length of stay, disposition, National Institutes of Health Stroke Scale (NIHSS) score, and race and ethnicity, were abstracted from the electronic medical record.

Radiographic Imaging Selection

We included radiographic imaging diagnostics deemed part of a stroke evaluation by the primary clinical team caring for a patient. Imaging studies included CT of the head, MR of the head, CT or MR angiogram of the head and neck, doppler ultrasonography of the lower extremities, CT venogram of the pelvis, and CT of the body (including chest and/or abdomen/pelvis). Only studies performed at the academic stroke center and interpreted by the stroke center radiologist were included in the study. All external imaging studies from patients who were transferred in from another hospital were excluded. Echocardiograms were excluded from the assessment of incidental findings; however, the presence or absence of an atrial level shunt was noted to determine the impact on further diagnostic evaluation.

Outcome Measures

Incidental findings were defined as any abnormality not related to the illness or causes that prompted the diagnostic imaging test (i.e., stroke). For example, findings such as small vessel disease related to hypertension were not included as parts of the study, while findings such as thyroid nodules were included. Incidental findings were identified by the impression, or interpretive report, of the interpreting radiologist obtained from the electronic medical record. This impression or interpretive report may be written by a radiology resident or fellow with editing or attestation by the faculty or attending radiologist prior to finalization of the read. Furthermore, an individual patient and an individual imaging study for a patient may have none or multiple incidental findings. A single incidental finding for a patient was only counted once within the radiographic study that first identified the abnormality. For example, if sinus disease was uncovered on an initial CT scan of the head, and was again observed on an MR image of the head in the same patient, the abnormality was attributed to the CT scan of the head. Previously diagnosed findings known prior to the stroke evaluation were not counted as incidental findings. One author (S.J.D.) performed the primary chart review. To ensure high reliability in the identification of incidental findings, 10% ($n = 20$) of patient charts were independently reviewed by two other authors (B.P.G., A.G.K.) resulting in 100% agreement in the identification of incidental findings.

Statistical Analysis

Results were reported descriptively. Differences by patient cohort or imaging study were evaluated using Chi-square, Student's *t*-test, and Wilcoxon-Rank Sum for proportions, means, and medians, respectively. Statistical evaluation was completed using STATA version 14.1 (College Station, TX).

Results

Among 200 stroke patients, 53 (26.5%) were found to have one or more incidental findings on radiographic imaging. No significant demographic or clinical differences were found between those with or without incidental findings (Table 1).

A total of 651 imaging studies were performed, with a mean of 3.3 imaging studies per patient (standard