

Incidental CT Findings in Trauma Patients: Incidence and Implications for Care of the Injured

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Background: The evaluation of patients with head, neck, and torso trauma frequently includes high-definition spiral computed tomography (SCT) scanning, which can reveal non-injury-related lesions. These incidental findings vary in their importance, from trivial lesions to findings that may have a greater impact on the health of the trauma patient than the injuries that led to the SCT. We evaluated the incidence and clinical importance of incidental findings found on SCT, and the effectiveness of a trauma practice guideline calling for appropriate management and follow-up.

Methods: The trauma registry was accessed to identify patients evaluated at an urban Level I trauma center from January to November, 2002. Trauma registry data, inpatient chart records, and the digital record of the filmless radiology archives were reviewed. Demographic data, including age, sex, type and mechanism of injury, and outcome, were recorded. All CT studies were reviewed for incidental

findings. Mucus retention cysts, sinusitis (except mastoiditis), degenerative joint disease, evidence of previous operation, and age-related cerebral atrophy were excluded. Incidental findings were divided into three categories based on clinical importance. Category 1 required attention before discharge. Category 2 required follow-up with primary doctor within 1 or 2 weeks, and Category 3 required no specific follow-up. Categories 1 and 2 were considered clinically significant findings.

Results: Complete data were available for 991 patients (677 men, 314 women). Eight hundred and forty-eight (85.6%) patients received at least one CT scan. A total of 289 incidental findings were discovered. Thirty-one patients (3.1%) had 36 Category 1 findings. There were 108 Category 2 and 145 Category 3 findings. When comparing those patients with at least one incidental finding, the incidence of incidental findings was higher in women than in men (34.1% versus 27.6%; $p < 0.05$). Older patients also had a higher

incidence of all categories of findings (over 40 versus 40 and younger: 46.1% versus 19.9%; $p < 0.001$). SCT yielded 90 (62.5%) of the clinically significant incidental findings in the abdomen/pelvis, 29 (20.1%) in the chest, and 25 (17.4%) in the head and neck. The charts of only 15 (48.4%) of the patients with Category 1 findings adequately documented the management of the incidental finding.

Conclusions: SCT for the evaluation of trauma patients reveals a significant number of incidental findings. These lesions are common in the abdomen and pelvis and show an increased incidence in women and among older patients. Although many require early follow-up and specialty physician referral, there was insufficient documentation of the management of these injuries. Incidental findings in the injured remain a significant challenge for trauma centers. An organized approach is required for successful follow-up and management.

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Many Americans lack access to routine health care and preventive services, resulting in poor health status and undiagnosed disease.¹ Trauma victims are no exception, and findings unrelated to injury are often uncovered by virtue of the comprehensive nature of the evaluation they receive at a trauma center. These incidental findings,

which vary from trivial lesions to major pathologic processes, are today increasingly discovered in patients evaluated for trauma through the widespread use of spiral computed tomography (SCT).

Incidental findings can pose a challenge to trauma patient management that far outweighs that created by the injuries that triggered the SCT. The need for further diagnostic workup, referral, and treatment is difficult to meet in the setting of a busy trauma service. Although the clinical significance of incidental findings on SCT has been reported in other populations, the success of trauma physicians in managing these findings has not been studied.²⁻⁶ Our objective was to review the frequency and clinical importance of incidental findings found on SCT of trauma admissions and evaluate the effectiveness of a practice guideline utilizing nurse practitioners to ensure appropriate management and follow-up.

PATIENTS AND METHODS

We conducted a retrospective trauma registry review of 1,014 consecutive admissions from January to November

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2002 to Scripps Mercy Hospital, an urban, Level I trauma center with an annual volume of approximately 2,150 patients. Twenty-three charts were either unavailable or incomplete. All scans were performed using a high-speed helical scanner (Somatom Volume Zoom 4-Slice CT Scanner, Siemens Corporation, New York, NY) and all studies were read by staff radiologists. Trauma registry data, inpatient chart records, and the digital record of the filmless radiology archives were reviewed. Demographic data, including age, sex, type and mechanism of injury, and outcome, were recorded. All SCT studies of the head, neck, chest, abdomen, pelvis, and spine were reviewed for the presence of incidental findings. Mucus retention cysts, chronic sinusitis (except mastoiditis), degenerative joint disease, evidence of previous operation, and age-related cerebral atrophy were excluded as clinically irrelevant. Incidental findings were divided into three categories based on clinical importance: Category 1 (required attention before discharge); Category 2 (required follow-up with primary doctor within 1 or 2 weeks); and Category 3 (required

Table 1 Category Definitions and Relative Distribution

Category	Definition	Distribution (n [%])
1	Required attention prior to discharge	36 (12.5%)
2	Required follow-up with primary doctor within 1-2 weeks	108 (37.4%)
3	Required no specific follow-up	145 (50.2%)

no specific follow-up) (Table 1). Categories 1 and 2 were considered clinically significant (Figure 1).

During the study interval, we implemented a practice guideline enforced by a nurse practitioner for the completion of referral and management of incidental findings. Plain film radiography was limited to chest and pelvis films in the trauma room, extremity and joint evaluation, and flexion-extension views of the spine when indicated. Most SCT of the chest was obtained in conjunction with all abdomen and pelvis SCT studies. Initial radiographic evaluation of the spine was also performed with SCT.

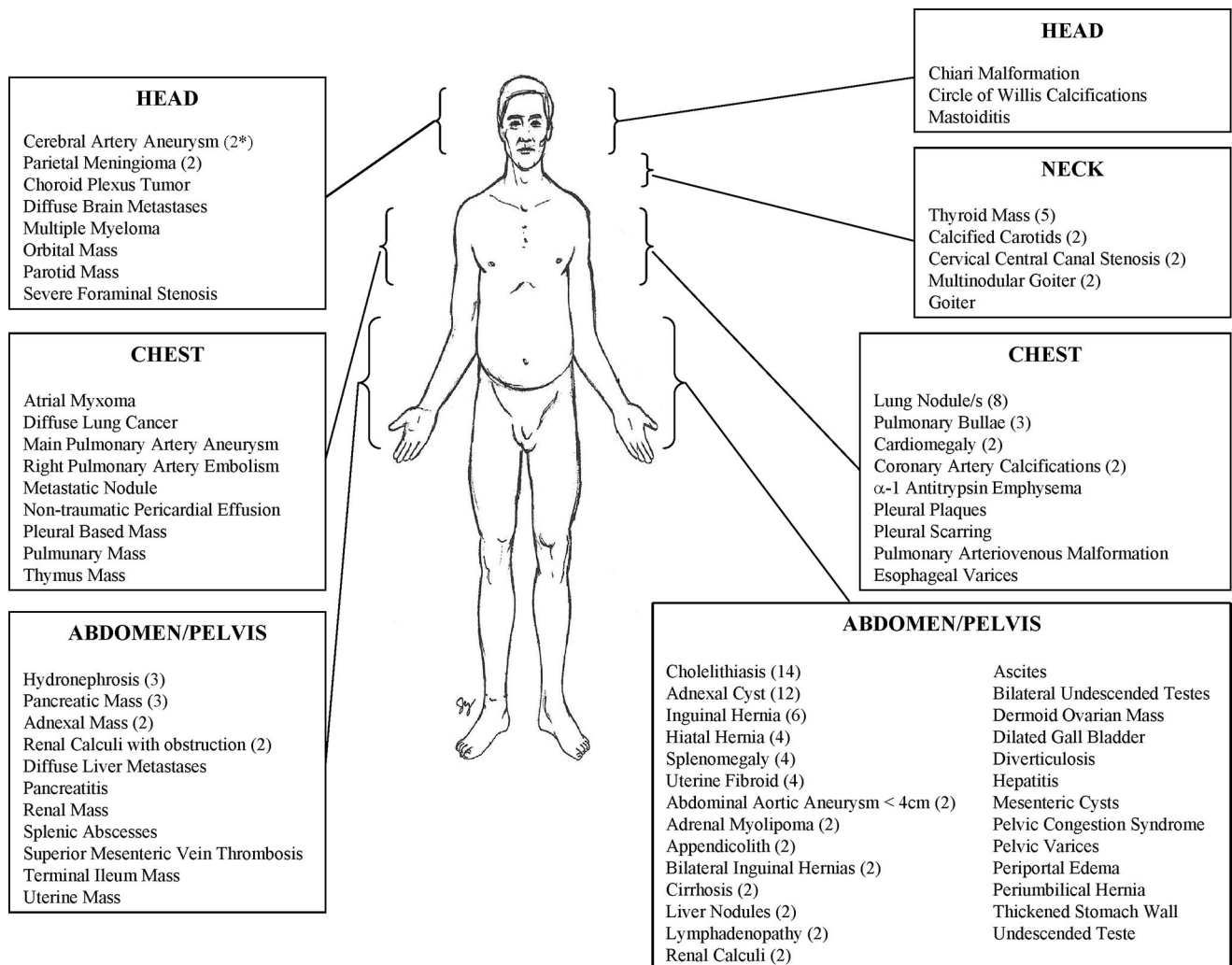


Fig. 1. Category 1 (left) and Category 2 (right) incidental findings. *Denotes number of duplicate patients with specific incidental findings.

Hospital charts of patients with Category 1 incidental findings were examined for evidence of documentation of the findings and evidence of clinical management or referral for further evaluation and treatment. Documentation was considered complete if there was evidence of operative or medical management (e.g., angiography), a dictated consultation from the appropriate specialist, or evidence of a scheduled outpatient evaluation. This study, its design, method of data acquisition, data collection devices, and confidentiality protections

were reviewed by the Scripps Mercy Hospital Institutional Review Board and approval to conduct the study was granted to the investigators.

RESULTS

Complete data were available for 991 patients. Eight hundred forty-eight patients (85.6%) received at least one SCT. There were 677 men and 314 women, with a mean overall age of 36 ± 18.1 (SD) years. A total of 289 incidental

Table 2 Master List of Incidental Findings of 991 Consecutive Trauma Patients According to Anatomical Location

HEAD (9.7%)*		
Absence of Corpus Colosum	Diffuse Brain Metastases	Orbital Mass
Aneurysm (2 [†])	Hydrocephalus	Meningioma (2)
Arachnoid Cyst (2)	Ischemic White Matter Change	Parotid Calcifications
Chiari Malformation	Lacunar Infarct/CVA	Parotid Mass
Choroid Plexus Tumor	Mastoiditis	Plagiocephalic Skull
Circle of Willis Calcifications	Multiple Myeloma	Severe Foramen Stenosis
Cystercercosis	Prior Brain Trauma	Old Craniotomy (5)
NECK (5.8%)		
Calcified Carotids (2)	Enlarged Paratracheal Lymph Node	Multinodular Goiter (2)
Calcified Thyroid Nodule (2)	Goiter	Thyroid Mass (5)
Cervical Central Canal Stenosis (2)	Lymphadenopathy (2)	
CHEST (15.9%)		
α -1 Antitrypsin Emphysema	Emphysema (3)	Pleural Plaques
Aberrant Subclavian Artery (2)	Granulomatous Disease (2)	Pleural Scarring
Aortic Calcifications (2)	Lung Nodule/s (8)	Pulmonary AV Malformation
Apical Blebs (2)	Main Pulmonary Artery Aneurysm	Pulmonary Bullae (3)
Atrial Myxoma	Mediastinal Mass	Pulmonary Mass
Bronchogenic Cyst	Metastatic Nodules	Right Pulmonary Artery Embolism
Calcified Mediastinal Lymph Node	Mitral Valve Calcifications	Right-Sided Aortic Arch
Cardiomegaly (2)	Paget Disease	Thymic Cyst
Coronary Artery Calcifications (2)	Pericardial Effusion	Thymus Mass
Diffuse Lung Cancer	Pleural Based Mass	
ABDOMEN/PELVIS (63.1%)		
Abdominal Aortic Aneurysm <4cm (2)	Dilated Gall Bladder	Pancreatitis
Absent Kidney (2)	Diverticulosis	Pelvic Congestion Syndrome
Adnexal Cyst (12)	Duplicate Left-sided Vena Cava	Pelvic Varices
Adnexal Mass	Esophageal Varices	Periportal Edema
Adrenal Adenoma (3)	Fatty Liver (7)	Periumbilical Hernia
Adrenal Granulomatous Disease	Hepatic Granulomatous Disease (2)	Renal Calculi without obstruction (2)
Adrenal Myolipoma (2)	Hepatitis	Renal Calculi with obstruction (2)
Appendicolith (2)	Hepatomegaly (4)	Renal Cyst (36)
Ascites	Hiatal Hernia (4)	Renal Mass
Atrophic Kidney	Horsehoe Kidney (2)	Renal Nodule
Bilateral Extrarenal Pelvices	Hydronephrosis (3)	Splenic Abscesses
Bilateral Inguinal Hernias (2)	Inguinal Hernia (6)	Splenic Cleft
Bilateral Undescended Testes	Intramuscular Lipoid Mass	Splenic Cyst (4)
Bladder Diverticuli (2)	Lipoma	Splenic Hemangioma
Bladder Stone	Liver Calcifications	Splenomegaly (4)
Clacified Hepatic Nodule	Liver Cyst (15)	Superior Mesenteric Vein Thrombosis
Cholecystic Fluid	Liver Hemangioma (3)	Terminal Ileum Mass
Cholelithiasis (14)	Liver Nodules (2)	Thickened Stomach Wall
Cirrhosis (2)	Mesenteric Cysts	Undescended Teste
Dermoid Ovarian Mass	Pancreatic Cysts	Uterine Fibroid (4)
Diffuse Liver Metastases	Pancreatic Mass (3)	Uterine Mass
SPINE (5.5%)		
Anatomical Variant of Lumbar Spine Body (2)	Interosseus Lesion	Schmorl Node (3)
Cervical Cystic Lesion	Os Odontium	Benign Sheath Neoplasm
Congenital Thoracic Cleft	Pars Defect (4)	Spina Bifida Occulta (2)

* Denotes percentage of total incidental findings in that anatomic region.

† Denotes number of duplicate patients with specific incidental findings.

findings were discovered (Table 2). Thirty-one patients (3.1%) had 36 Category 1 findings (Fig. 1). There were 108 Category 2 findings (Fig. 1) and 145 Category 3 findings (Table 1).

When comparing those patients with at least one incidental finding, the overall rate of incidental findings was higher in women than in men (34.1% versus 27.6%; $p < 0.05$), and this was also true for Category 1 findings (5.1% versus 2.2%; $p < 0.05$). Older patients also had a higher incidence of all categories of findings. When comparing those patients older than 40 years with those younger, the number of patients with at least one incidental finding was much higher in the older patients (46.1% versus 19.9%; $p < 0.001$). SCT of the abdomen and pelvis yielded the highest number of incidental findings; SCT of the spine had the lowest yield (Table 2). Many of the incidental findings represented life-threatening processes that had remained clinically silent. These included many unsuspected tumors. An example of one of these lesions is displayed in Figure 2.

A detailed review of the charts of patients with Category 1 incidental findings revealed a consistently poor rate of documentation of both the incidental findings and the management or referral for these lesions. Only 19 (53%) of 36 applicable Category 1 findings in 15 (48.4%) of 31 patients

were found to have chart documentation of treatment, follow-up, or referrals. Documentation was routinely missing or inadequate in discharge summaries.

DISCUSSION

We found that incidental findings were common on SCT for evaluation of blunt trauma patients. Three percent of patients were found to have lesions of clinical importance sufficient to require immediate management or referral. Although not investigated on an individual basis, many of these trauma patients may have had incidental findings of far greater health importance than their relatively minor injuries. Incidental findings were more common in older patients and in women. Not surprisingly, the majority of findings were discovered on SCT of the abdomen and pelvis; however, studies of the chest and other areas also resulted in the discovery of numerous significant lesions. Previous studies addressing incidental findings through SCT use during the evaluations of pulmonary embolism and kidney stone disease yielded similar numbers of clinically significant findings and a lack of adequate documentation of follow-up.^{2,3}

The increasing numbers of elderly trauma patients⁷ will make incidental findings more likely in view of our findings of a higher rate among older patients. This group is already

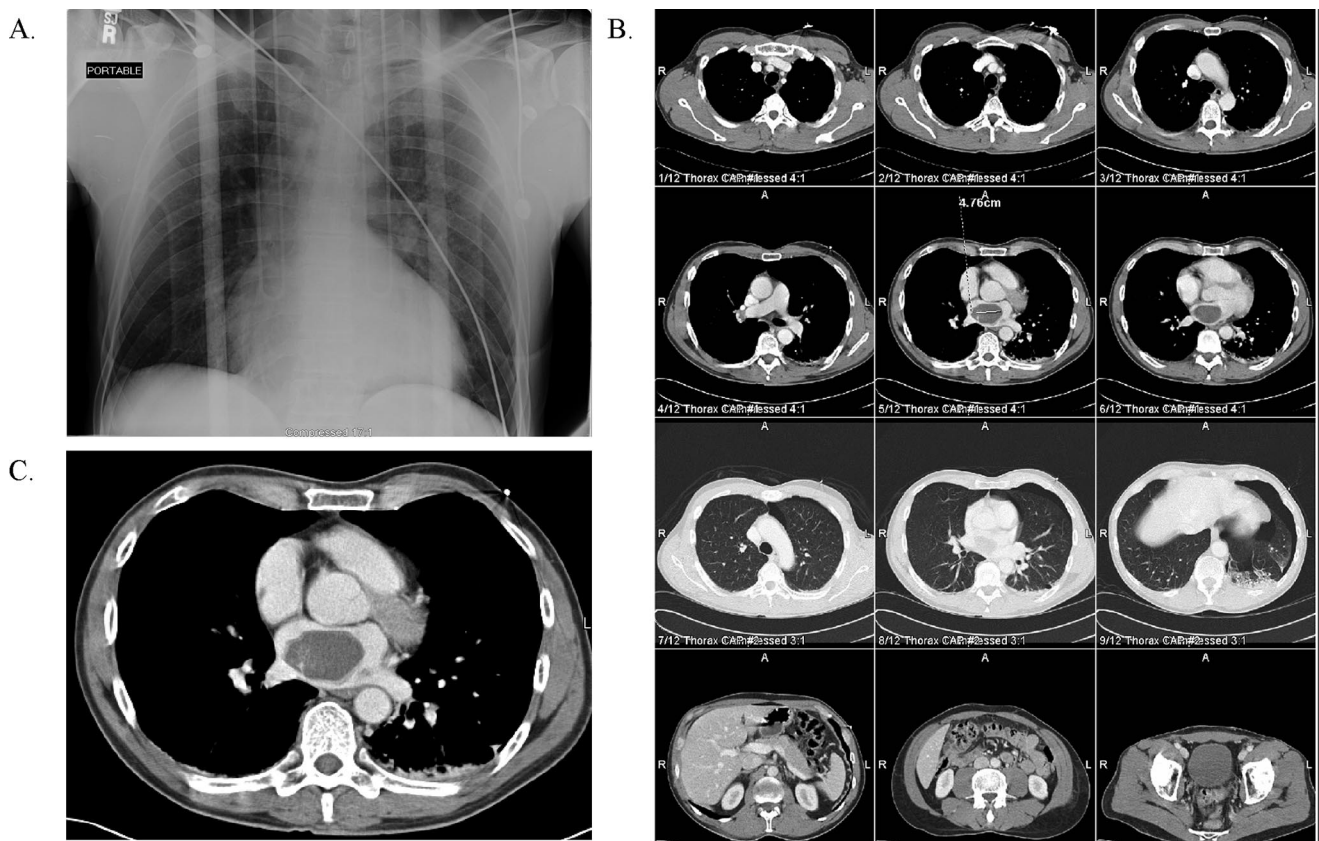


Fig. 2. (A) Normal anteroposterior chest radiograph obtained in the trauma room in a 54-year-old man with lower-extremity fracture from a motor vehicle crash. (B) Spiral computed tomography of the chest, abdomen, and pelvis. (C) There is a large asymptomatic left atrial myxoma. The patient underwent successful elective resection 1 month later.

challenging to care for due to the high rate of significant comorbidities.^{8,9} The integration of trauma care into the overall plan of management of the elderly patient's other problems is an important task to accomplish after injury. The prevalence of incidental findings of clinical significance increases the challenge for the trauma service.

Despite our trauma practice guideline, we found that the charts of patients with Category 1 findings revealed a significantly high rate of poor documentation of both the incidental findings and the subsequent management or referral. Discharge summaries were particularly lacking in adequate documentation of the management, plan for follow-up, or referral of these findings. This represents a significant opportunity for quality improvement. Clearly, these are the very type of incidental findings that should not be ignored and that can significantly change patient management. Without evidence of further work-up they may represent serious diagnoses with clinical and legal ramifications. In view of the lack of routine health care in many trauma patients, it is likely that if the trauma service fails to provide for management and follow-up, it may well not be provided by any alternate source.

In an era when SCT use in trauma patients is growing, how to effectively deal with incidental findings is a question that deserves further consideration and study. The hallmark of trauma care is rapid diagnosis, treatment, and transition to rehabilitation or home. Most injuries do not produce permanent disability or the need for long-term follow-up. In this framework, nontrauma diagnoses apparently do not receive the same aggressive approach. Successful management and referral will require rethinking the care of the injured patient.

Trauma services that employ nurse practitioners (NPs) may be at an advantage with respect to this problem. NPs create more consistent attention to the details of preparation for discharge and follow-up. It has been shown that the addition of NPs to the trauma team increases the quality of documentation, improves the completeness of discharge summaries, and decreases readmissions after discharge, failures to fill prescriptions, and failures to follow up.^{10,11} The successful management and referral of incidental findings may best be addressed and coordinated by these nonphysician providers.

Several limitations to this study deserve discussion. First, it was conducted at a single Level I trauma center, so generalization of the results is limited. Second, it designates clinical significance retrospectively to the incidental findings. Categories 1 and 2 were designated "clinically significant" incidentals. Many of the Category 2 incidentals were findings of likely pre-existing chronic disease (e.g., cirrhosis, coronary artery calcifications, emphysema), which may have complicated a trauma admission as much as any newly discovered Category 1 incidental finding, especially in patients requiring critical care for their traumatic injuries. This influence would be difficult to quantify.

Finally, this study equates failure to document management or referral of clinically significant incidental findings in the hospital chart as a de facto failure to follow-up. Although

unlikely, it may be that in some cases follow-up was achieved but simply poorly documented. The logistics of our busy trauma service may have contributed to this situation. Nonetheless, the trauma practice guideline in effect at the time called for adequate documentation, and the issue of potentially serious incidental findings without follow-up only serves to underscore the need for better communication among practitioners.

CONCLUSION

SCT for the evaluation of trauma patients results in a significant number of incidental findings. These lesions are more common in the abdomen and pelvis and have an increased incidence in older patients. Many of these findings require early management or referral to specialty physicians. Despite an awareness of the prevalence of these findings and a trauma practice guideline to complete the management and referral for them, there was insufficient documentation in the majority of patients' charts. Incidental findings in the injured remain a significant challenge for trauma centers. An organized approach is required for successful follow-up and management.

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