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Original Article

The role of head CT scans in the evaluation of acute intracranial injuries

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ABSTRACT

Objective: To assess the incidence of clinically significant intracranial injuries identified by head CT for patients who fell during their stay at an inner city hospital. **Design:** Retrospective chart review. **Setting:** Acute inpatient rehabilitation unit of an inner city hospital. **Participants:** A total of 346 patient falls, documented during their hospital course. **Interventions:** Retrospective chart review of head CT-scans that were obtained for patients who fell during their stay on an inpatient rehabilitation unit over a 3-year period. Charts were reviewed for the following: results from the physical examination following discovery of the incident, evidence of intracranial injury as a consequence of the fall, and any prolonged hospitalization as a result of the fall associated intracranial pathology. **Main Outcome measures:** Results of head CT-scans. **Results:** 110 head CT scans (31.79%) were obtained as part of the workup in a total of 346 patient falls that had a documented fall during their hospital stay. Each patient analyzed had between one and three head CT scans performed as a result of a fall. Only 1 of 110 head CT scans performed (0.91%) had a positive acute finding for a head injury. This patient required two follow up head CT scans. **Conclusions:** There is a low diagnostic yield and high cost for head CT scans as part of the post-fall evaluation in patients not exhibiting acute neurological changes. Physiatrists should use caution when ordering these imaging studies and limit their use to occasions when clinically indicated according to institution guidelines based on a clinical decision aid.

KEY WORDS: Inpatient falls; Head CT; Fall related imaging; Acute hemorrhage; Cost reduction; Patient safety

INTRODUCTION

Patient falls are a major concern during a patient's stay at a hospital due to the risk of injury to the patient, increased hospital stay and of increased hospital expenditure.[1] 2.5% to 15% of patients admitted to hospitals fall during their hospitalizations and 4% to 6% of falls result in serious injury[2,3]. Hospitalized patients are at an increased risk of falls due to an increase in risk factors including: acute illness, unfamiliar environment and side effects of new medications[4, 5]. Patient related risk factors for falling such as gait deficit, balance deficit, lower extremity problems, or confusion are particularly interesting to specialties like Physical Medicine and Rehabilitation that commonly treat patients with such deficits[5]. After a fall in the hospital or a minor head injury, a patient with or without focal findings will often undergo a head CT scan for a rapid and reliable diagnosis of an intracranial hemorrhage and other complications[6,7]. However, the usefulness of a head CT after minor head trauma has been controversial as the CT scan is costly and a CT scan exposes the patient to potentially unnecessary radiation[8,9]. In this study, our purpose was to assess the possibility of further limiting head CT scans as part of a post-fall evaluation in patients without any acute neurological findings.

METHODS

Retrospective chart review of 346 patients whom fell while admitted to an inner city inpatient rehabilitation facility (IRF) from 2012 to 2014. Patients' data was sorted by year and medical unit: 163 falls were reported in 2012, 98 falls were reported in 2013, and 85 falls were reported in 2014. Patients were all inpatients during the time of their fall in a Traumatic Brain Injury unit (TBI), an IRF, or a Medicine Unit that contained rehabilitation patients.

Any reported fall, regardless of the setting, on these units from 2012 – 2014 was examined as part of the data. Repeat falls by patients were treated as separate falls. Although some patients had additional imaging for other fall related injuries, only head CT scans were evaluated in this study. An acute brain injury post-fall was defined as any acute changes noted on the head CT scan. Such a change would show any new intracranial bleed that was not present before with or without a midline shift. Any amount of bleed that is new was considered an acute change.

RESULTS

Medical records were examined for patients that fell during a stay at an inpatient rehabilitation facility. There was a total of 346 falls throughout the 3 units. Of the 346 falls, 110 total head CT scans were performed and only 1 scan in 2012 showed acute changes. As shown in Figure 1, the three different units performed head CT scans after falls at a different rate: the TBI Unit performed a head CT scan in 22.92% of falls (22 of 96 falls), the Medicine Unit performed a head CT scan in 54.32% of falls (44 of 81 falls), and the PM&R Unit performed a head CT scan in 26.04% of falls

(44 of 169 falls). The PM&R Unit revealed the only positive CT scan of the 3-year chart study. Each floor has decreased its head CT scan utilization post-fall dramatically in the third year of the study (2014), as shown in Figures 2, 3, and 4.

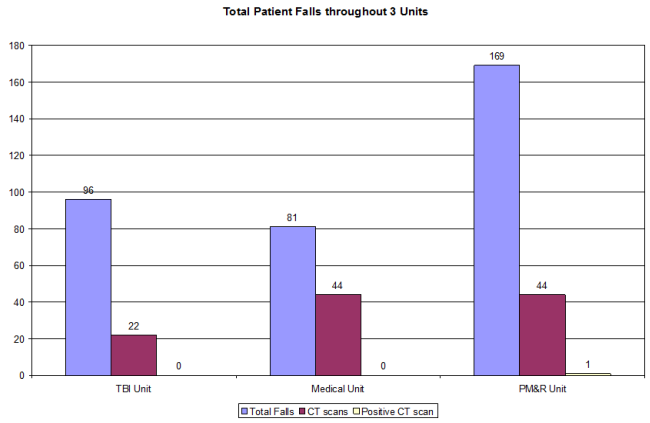

Figure 1.

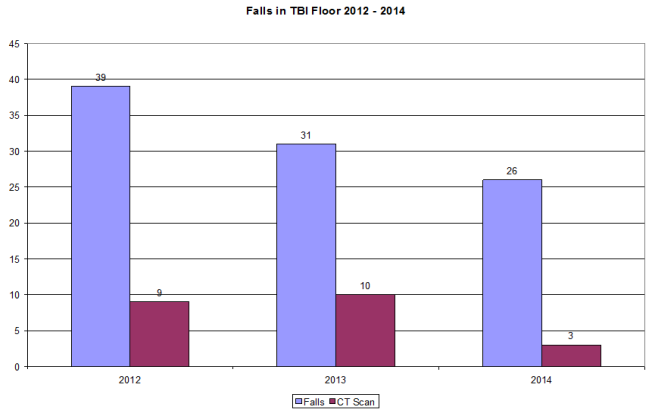

Figure 2.

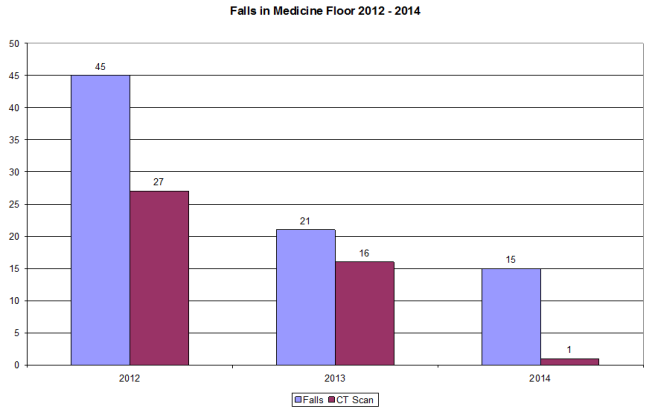

Figure 3.

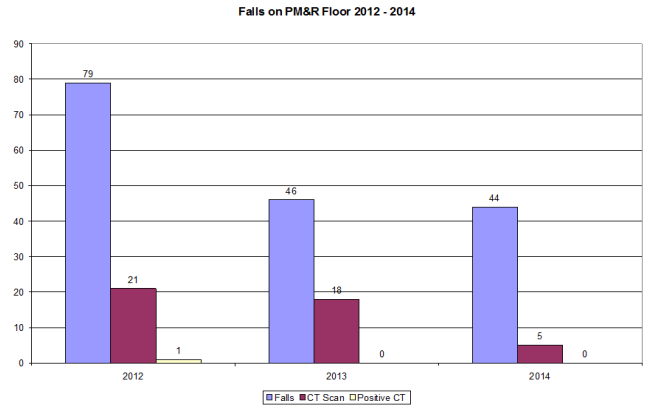

Figure 4.

The decrease in CT scans can be attributed to an educational campaign within the hospital unit to encourage thorough neurological examination prior to CT scans to examine its necessity. Education for the staff on the topic was provided through case presentations, safety committees, and unit meetings. Also, proper communication during sign-outs and handoffs were emphasized regarding any high risk patients. Health providers were consistently reminded that, when deemed necessary, a head CT post fall was encouraged. After the first year of the study showed a significantly low yield for patients in identifying any acute pathologies post fall in patients with no direct head trauma, it was stressed to fully examine the patient and evaluate the history of the fall before ordering a head CT scan.

DISCUSSION

During the three-year study at the acute inpatient rehabilitation facility the rate of a positive CT scan for an acute intracranial injury after an inpatient fall was 0.91%. The one positive finding resulted in medical fees equivalent to 15% of the amount spent on negative CT scans post inpatient fall. Due to increased awareness by resident physicians on the importance of a thorough neurological examination and proper history taking regarding falls, the rate of head CT scans decreased by the third year of the study without any adverse outcomes (35.0% of falls received head CT scans in 2012, 45.0% in 2013, and 10.6% in 2014).

A thorough neurological exam is the cornerstone to assessing the necessity for a head CT scan post fall. A neurological exam must be comprehensive in order to identify any potential lesions. The exam should include evaluation of the patient's general appearance including level of consciousness and vital signs. A mini mental status exam and an exam of Cranial Nerves I – XII should be performed. When examining the extremities there are several systems to evaluate: motor strength and muscle tone, sensory perception to light touch, sharp touch and proprioception and reflexes of upper and lower extremities. Coordination must also be examined by having the patient perform rapid alternating movements, point-to-point movement tests (for example, heel to shin test) performing

the Rhomberg test and examining the patient's gait. Any acute findings on physical exam should prompt a head CT, especially high risk signs such as: Glasgow Coma Score <15/15, any loss of consciousness, suspected skull fracture, cervical pain or tenderness, amnesia post injury, seizure, or significant swelling or hematoma formation while on anticoagulation therapy.

A 2009 study showed through the use of a coordinated decision guideline, the amount of head CT scans after a mild traumatic brain injury may be reduced by nearly 50%[10]. When applied to inpatient falls that may or may not involve a head injury, there is an opportunity to reduce head CT scans without missing acute changes by a thorough examination based on a clinical decision aid such as National Emergency X-Radiography Utilization Study II (NEXUS-II) or the Scandinavian Neurotrauma Committee guideline[11,12]. Some clinical decision instruments have been validated and used to influence clinical practice[13-15]. Because of the potential adverse outcomes, any acute intracranial injury should not be missed and the physician must have full confidence there are no indications prior to forgoing from a head CT scan.

An additional area to decrease head CT scans performed after falls were serial CT scans. After blunt head trauma or closed head injuries, it has been demonstrated that a single negative CT scan can be followed by clinical observation rather than serial head CT scans[16, 17].

CONCLUSION

Finding acute intracranial changes after an inpatient fall is a priority however, studies have evaluated the usefulness of clinical decision instruments in order to place emphasis on decreasing the need for unnecessary head CT scans in minor head trauma. While clinical exams cannot always replace the necessity of a head CT scan, there do exist opportunities to decrease imaging by performing thorough neurological and physical exams in coordination with an accurate description of the event of the fall. Trending down unnecessary imaging allows for cost savings for the hospital and the patient, with less radiation exposure to patients. The IRF studied decreased the use of head CT scans post inpatient fall without risking patient safety by ensuring any patients with indications for a scan received the necessary test however, a more selective process was encouraged as residents and attending physicians were more aware of the initiative.

When warranted due to direct head trauma or multiple neurological findings, it is vital to pursue a head CT scan to accurately detect any acute lesions. Further education and continuous training for resident physicians, attending physicians, and nursing staffs about preventing falls and fall precautions will continue to decrease falls, thus decreasing the need for any further interventions. The acute IRF studied displayed one acute intracranial change after a fall within a three-year timeframe as it continued to trend towards less head CT scans post fall. Low incidence of acutely abnormal head CT scans exists in the population of patients whom fell while in an IRF. Further research regarding the validity, clinical application, and cost effectiveness of clinical decision instruments is necessary to advance physicians confidence towards bypassing a head CT scan after an inpatient fall.

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