


Original Article

Incidental findings on whole-body computed tomography in trauma patients: the current state of incidental findings and the effect of implementation of a feedback system

Keisuke Kumada,¹  Nobuo Murakami,¹ Hideshi Okada,² Izumi Toyoda,^{2,3} Shinji Ogura,² and Takahiko Asano⁴

¹Patient Safety Division, Gifu University Hospital, ²Department of Emergency & Disaster Medicine, Gifu University School of Medicine, ³Department of Emergency Medicine, Gifu Prefectural Medical Center, and ⁴Department of Radiology, Gifu University School of Medicine, Gifu, Japan

Aim: Whole-body computed tomography (CT) for trauma occasionally reveals significant incidental findings not related to trauma, which require an adequate response. In this study, we examined the current state of incidental findings in trauma patients on whole-body CT and the effects of the feedback system.

Methods: The subject sample included trauma patients who underwent whole-body CT while being examined for trauma during the 2-year period, with the interpretation of the CT reported by a radiologist. The frequency and recognition of incidental findings and the involved body region were investigated. The state of incidental findings before and after implementation of a radiography report feedback system was also examined.

Results: During the study period, whole-body CT revealed incidental findings in 79 of 199 trauma patients (40.1%). The mean age of the 79 patients with incidental findings was 62.8 ± 19.5 years, and the mean injury severity score was 16.6 ± 10.0 . No difference was observed in the severity of trauma, age, or length of hospital stay. The incidental findings were related to the liver/gallbladder in 22 patients, kidneys in 17, lungs in 14, and the intracranial area in 13. The recognition rate of incidental findings after the implementation of the feedback system increased from 23.3% to 32.6%.

Conclusions: Considering that not all incidental findings are accurately recognized, a proper feedback system is required. A feedback system is beneficial and a need to ensure improvement in the recognition of incidental findings.

Key words: CT scan, feedback system, incidental finding, trauma

INTRODUCTION

IN THE JAPAN Advanced Trauma Evaluation and Care guidelines, whole-body computed tomography (CT) for trauma is regarded as an efficient evaluation method that considers the timing for trauma care and is frequently implemented at various medical institutions.¹ Imaging for trauma can, however, incidentally reveal significant findings other than those resulting from trauma in 48–68% of cases.² Such incidental findings could include early malignancies or vascular lesions and are problematic when sufficient follow-up

is not carried out. In addition, they might not always be documented clearly on the patients' charts, leading to inappropriately organized follow-up and missed referrals. Furthermore, despite the documented problems associated with incidental findings, there are no published studies investigating feedback system and their effects.

The primary aim of the present study was to determine the current state of incidental findings during whole-body CT undertaken on trauma patients at the Advanced Critical Care Center of Gifu University Hospital (Gifu, Japan). The secondary aim was to examine the effect of implementing a feedback system.

METHODS

THE SUBJECT SAMPLE included patients who underwent whole-body CT, which was interpreted by a radiologist, at the time of their initial examination for

Corresponding: Keisuke Kumada, MD, Patient Safety Division, Gifu University Hospital, Yanaido1-1, Gifu, ZC: 501-1194 Japan. E-mail: kkumada@gifu-u.ac.jp.

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trauma at the Advanced Critical Care Center of Gifu University Hospital during the 2-year period from April 2015 to March 2017. Retrospective investigation was carried out for the following items: (i) frequency, details, and recognition of incidental findings and the involved body region (intracranial, neck [thyroid gland], cervical spine, lungs, liver/gallbladder, kidneys, major blood vessels, pelvis, intestinal tract, and other areas), (ii) comparison of the groups with and without incidental findings, (iii) comparison of the situation before and after implementation of the feedback system. Patients who only underwent CT of the area local to their trauma to determine the mechanism of injury at the time of initial examination were excluded. The recognition of incidental findings was defined by any of the following: description in medical records, additional imaging carried out, follow-up observation after discharge, or details of incidental findings listed in a referral in the event of hospital transfer. Incidental findings were based on the radiology interpretation report from the department of radiology written by two physicians (including a radiologist) and used to sort the patients into two groups (categories). Category A included patients with incidental findings requiring emergency intervention or further detailed examination, whereas category B included patients with incidental findings not requiring close examination. We excluded the findings known to exist prior to the injury (detected during prior imaging or based on medical history). In addition, we excluded cases involving age-related bone and joint degenerative disease, atherosclerotic changes, and age-related cerebral atrophy. Furthermore, for countermeasures, we added a feedback system to inform the characteristics and importance of incidental findings to emergency physicians. A feedback system to check whether the radiology interpretation report had been read was classified into pre-countermeasure implementation (shortened to pre-countermeasures: April 2015–January 2016) and post-countermeasure implementation (shortened to post-countermeasures: February 2016 and after). Notification of failed incidental finding identification is included in radiology reports. The checking system included feedback from a medical clerk that is directly transferred to the attending physician and is listed in electronic medical records if the radiology interpretation report had not been read (Fig. 1). The feedback system is managed by the Division of Medical Safety Management. The 239th institutional review board of Gifu University School of Medicine gave their approval for this study to be carried out (29-134).

Numeric values are shown as the mean \pm standard deviation, and a P -value ≤ 0.05 obtained by Student's t -test and χ^2 -test was considered to indicate statistical significance.

RESULTS

Frequency of incidental findings

DURING THE STUDY period, whole-body CT was carried out on 197 trauma patients, among whom incidental findings were detected in 79 (40.1%). The 79 patients (53 men and 26 women) with incidental findings had a mean age of 62.8 ± 19.5 years and a mean injury severity score (ISS) of 16.6 ± 10.0 . Outcomes included hospital discharge in 34 patients, hospital transfer in 37 patients, death in 7 patients, and another outcome (hospitalization) in 1 patient. According to the body region, the incidental findings were related to the liver/gallbladder in 22 patients, kidneys in 17, lungs in 14, the intracranial area in 13, and other regions in other patients. Findings in multiple regions were observed in 17 patients. Category A comprised 13 patients (16.3%) including 5 with a lung mass, 2 with cervical spine abnormalities, and 6 with other findings. Category B comprised 66 patients (83.7%; Fig. 2). With regard to the frequency of recognition, incidental findings were recognized in 10 patients (76.9%) in category A. Of these patients, findings were listed in the medical records of 10, with 8 of them undergoing additional imaging. In category B, incidental findings were recognized in 13 patients (19.6%); among them, findings were listed in the medical records of 9 patients, with 6 of them undergoing additional imaging. Notably, there were no cases with incidental findings affecting the length of hospital stay or outcome.

Comparison of groups with and without incidental findings

We compared 79 patients with incidental findings and 120 patients without incidental findings. The patients with incidental findings (53 men and 26 women) had a mean age of 62.8 ± 19.5 years, a mean ISS of 16.6 ± 10.0 , and a mean hospital stay of 23.4 ± 23.1 days, whereas those without incidental findings (90 men and 30 women) had a mean age of 40.8 ± 24.4 years, a mean ISS of 18.2 ± 11.3 , and a mean hospital stay of 18.2 ± 19.3 days. No significant differences were observed between the two groups.

Findings before and after implementing a feedback system

Among the 79 patients with incidental findings, findings were recognized prior to countermeasure implementation in 30 patients and after countermeasure implementation in 49 patients (Table 1). In category A, recognition was documented prior to countermeasure implementation in 66.7%

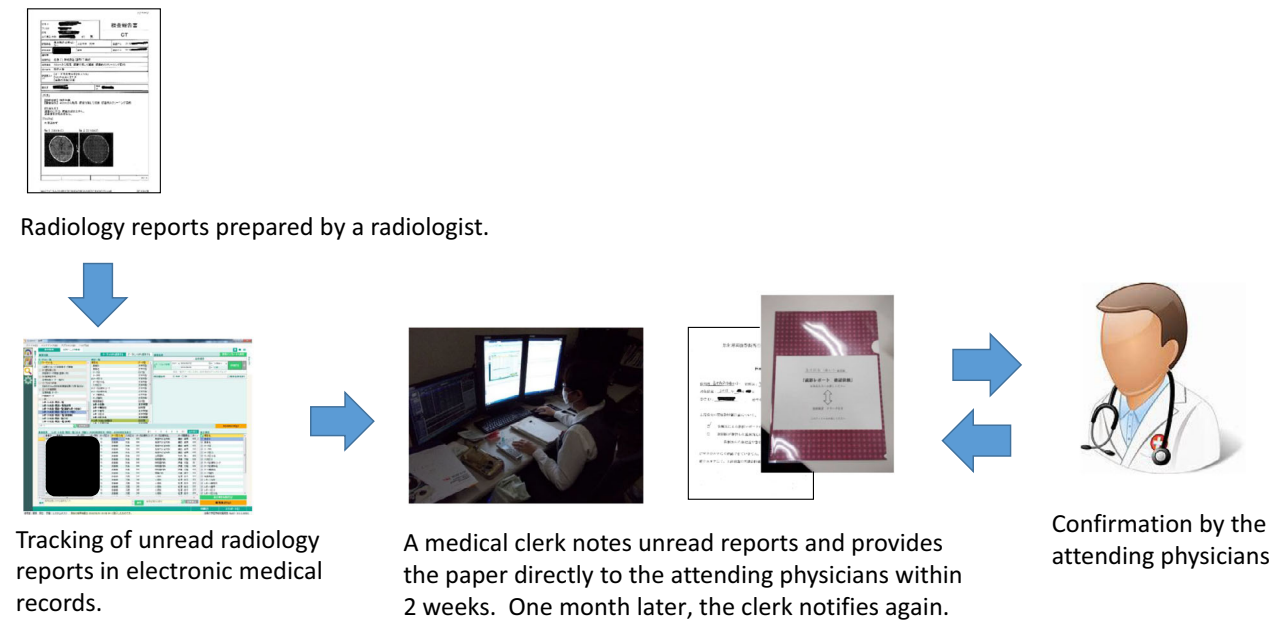


Fig. 1. Feedback system for unread radiology reports at the Advanced Critical Care Center of Gifu University Hospital (Gifu, Japan). The feedback system is managed by the Division of Medical Safety Management.

(four of six patients) and after countermeasure implementation in 85.7% (six of seven patients). In category B, recognition was documented prior to countermeasure implementation in 12.5% (3 of 24 patients) and after countermeasure implementation in 23.8% (10 of 42 patients). Overall, the rates of incidental finding recognition were 23.3% prior to countermeasure implementation and 32.6% after countermeasure implementation. Furthermore, after countermeasure implementation, all radiology interpretation reports were read and direct feedback was given to the attending

physician by the Division of Medical Safety Management in all cases without documented recognition in category A.

DISCUSSION

INCIDENTAL findings at the time of imaging require careful examination, even when the case is not urgent. Problems can arise if these imaging findings subsequently turn out to be significant. Incidental findings not only depend on the ability to interpret imaging tests but also become a problem if the radiology interpretation report prepared by a radiologist is not adequately verified. The Japan Council for Quality Health Care has addressed this concern by issuing an alert about the importance of verifying interpretation reports prepared by radiologists.³ On the basis of our results, we will discuss the need for countermeasures for incidental findings based on our understanding of the current state of incidental findings on CT in trauma patients.

Characteristics of incidental findings

Many reported cases of incidental findings on CT exist, the frequency of which in trauma was reported to be 44.5% by Sierink *et al.*⁴ and 43% by Munk *et al.*⁵ Hann *et al.*,⁶ meanwhile, reported detecting incidental findings in 64% of cases in an investigation of emergency outpatient services. With regard to the body region, incidental findings are most commonly recognized in the ovaries, lungs, liver, and kidneys.⁶

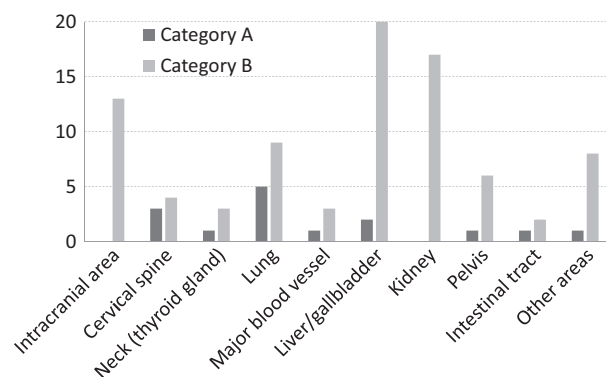


Fig. 2. Number of trauma patients who underwent whole-body computed tomography and incidental findings by body region. Category A, further diagnostic work-up required; Category B, findings of minor concern and no diagnostic work-up required.

Table 1. Recognition rate of incidental findings in patients who underwent whole-body computed tomography for trauma: before and after the implementation of a feedback system

	Before <i>n</i> = 30	After <i>n</i> = 49
Category A <i>n</i> = 13	66.7% (4/6)	85.7% (6/7)
Category B <i>n</i> = 66	12.5% (3/24)	23.8% (10/42)
Total <i>n</i> = 79	23.3% (7/30)	32.6% (16/49)

$\chi^2 = 0.438$; $P = 0.508$. Category A, further diagnostic work-up required; Category B, findings of minor concern and no diagnostic work-up required.

The frequency is considered higher among patients who undergo whole-body CT than in those who undergo selective CT.⁷ Incidental findings include those that require immediate intervention, such as vascular disease, those that require further closer examination, such as tumors, and those that do not require closer examination. Findings that require immediate intervention affect the direction of treatment. In the present study, we classified incidental findings into those that require closer examination and those for which follow-up observation was possible, in accordance with the classifications of Yeh *et al.*⁸ and Sierink *et al.*⁴ As a result, the frequency of incidental findings was comparable to that cited in previous reports, at 40.1%, of which 16.3% required closer examination. No difference was seen in the severity of trauma, age, or length of hospital stay, and although incidental findings were commonly noted in the liver or kidneys, closer examination was often required for incidental findings related to the lungs. Regarding the recognition of incidental findings, James *et al.*⁹ reported that only 12 of 416 trauma patients (1.4%) in whom incidental findings were identified had their incidental findings documented at the time of hospital discharge, whereas Fakler *et al.*¹⁰ reported a frequency of incidental findings of 47.2%, with no record of these findings in any of the discharge summaries. Devine *et al.*¹¹ and Thompson *et al.*¹² similarly viewed the absence of follow-up observation for incidental findings as a problem. In the present study, recognition of incidental findings was improved by specific intervention, such as measures to check whether the radiologists' interpretation reports had been read; however, patients who required closer examination had this documented in their medical record but did not receive

follow-up, which shows that the implementation of these countermeasures is imperative.

Measures for incidental findings

Yeh *et al.*⁸ reported that sharing information pertaining to incidental findings with a patient's primary care doctor helps ensure reliable follow-up observation. Furthermore, Seah *et al.*¹³ suggested countermeasures for incidental findings, including listing in medical records, clarifying follow-up, clarifying consultation services, sharing information, and listing findings, in discharge summaries. However, it is first up to the attending physician to recognize the importance of incidental findings. To realize this, the following four points are important: (i) to improve the image interpretation ability of attending physicians who request imaging tests, (ii) to have the results of the radiographic examinations interpreted by more than one physician (preferably including a radiologist), (iii) to implement countermeasures to ensure that all radiology interpretation reports are read, (iv) to create a system to check the documentation of incidental findings in medical records. At our hospital, joint conferences are held by the Advanced Critical Care Center and Department of Radiology to address the first goal, and a system has been developed to ensure that incidental findings can be interpreted by a radiologist 24 h a day to address the second goal. In addition, to address the third and fourth goals, our hospital employs medical clerks to list unread reports, encourage each individual physician concerned to read the radiology interpretation report, and review medical records to check that incidental findings have been documented. In future, we also plan to use electronic medical records to introduce an alarm function for non-verified radiology interpretation reports.

Computed tomography and other imaging tests are becoming increasingly accessible in emergency care settings, thus increasing the number of imaging cases. The frequency of discovering incidental findings will also increase the risk of overlooking important findings. Physicians in emergency care have difficulty providing ongoing medical care in emergency room and other settings. Furthermore, radiologists should consider the best method to communicate the information of incidental findings to emergency physicians; they share liability for failure of communication if patients are not appropriately informed of such clinically relevant findings. In clinical practice, incidental findings are bound to be encountered, and these findings can be easily mismanaged and impact patient outcome. Therefore, they must carefully consider the suitability of the imaging examination and understand the characteristics of incidental findings to provide more reliable treatment.

Limitations

This study had a number of limitations. First, whole-body CT for trauma is done in accordance with the Japanese guidelines for the management of trauma. Second, this study was undertaken at a single institution and was limited to trauma patients. Finally, this was a retrospective study using medical records as data.

CONCLUSION

WE EXAMINED THE current state of incidental findings in trauma patients at the Advanced Critical Care Center of Gifu University Hospital. The frequency of incidental findings was 40.1%, with closer examination required in 16.3% of cases; however, we found that not all findings were reliably recognized. A new system to provide direct feedback in the form of radiography interpretation reports was found to increase the rate of incidental finding recognition. The construction of a feedback system is important because of the limitations in recognizing incidental findings by physicians who provide emergency care.

DISCLOSURE

Approval of the research protocol: This study was carried out with the approval of the ethics committee of Gifu University School of Medicine (No. 29-134).

Informed consent: N/A.

Registry and registration no. of the study/trial: N/A.

Animal studies: N/A.

Conflict of interest: None declared.

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