

Original Article

A study of the usefulness of inspection of radiology reports in the emergency room

Toru Koyama,¹ Shouichi Yoshiike, Kazuki Suganuma, Kosuke Shiroto, Naoto Miyauchi, Sayaka Shinchu, and Yoshihiro Aoki

Department of Emergency and Critical Care Medicine, Aizawa Hospital, Nagano, Japan

Aim: The aim of this study was to better understand the usefulness of retrospective inspection of radiology reports of CT (computed tomography) or MRI (magnetic resonance imaging) by emergency doctors in the emergency room.

Methods: Between April 2018 and March 2019, patients who went home after CT or MRI who needed to change their treatment plans and subsequent corresponding procedures after inspection of radiology reports by emergency doctors were reviewed.

Results: Among 7,661 CT or MRIs performed on 5,917 patients, there were 131 patients (133 CT or MRI or 1.7% among 7,661 examinations) who required a change in their treatment plans after inspection of radiology reports. Of the 133 CT or MRI performed, there were 51 (38.3% among 133 CT or MRI, 0.7% among 7,661 examinations) CT or MRI performed, which indicated findings to suspect a tumor (11.8% in the head, 41.2% in the chest, 35.3% in the abdomen, and 11.8% in others). With the need to make important changes in treatment plans, making appointments for outpatient clinics was necessary for 52 CT or MRI findings, and requiring the patients to return to the clinic or be admitted was necessary for 9 (totally 61; 0.8% among 7,661 examinations).

Conclusion: Data from this study suggest that inspection of radiology reports of CT or MRI by emergency doctors after patients went home is useful in finding characteristics suggestive of tumors in 0.7% of all radiology reports and is necessary to identify important changes that should be made in treatment plans in 0.8% of all radiology reports.

Key words: CT/MRI, imaging study, radiologist, US-originated emergency medicine

INTRODUCTION

AFTER THE INTRODUCTION and spread of Western Medicine-based emergency treatment procedures in Japan, doctors are expected to treat different kinds of patients who may present with various seriousness levels. As a result, in Japan, there is a rise in the utilization of computed tomography (CT) or magnetic resonance imaging (MRI) in emergency rooms.^{1–3} The state of radiology in Japan is characterized by a huge gap between the number of imaging units available and the amount of diagnostic reporting performed.^{4–6} In particular, CT or MRI managed by radiologists is limited, especially during nighttime or holidays. Although the utilization of teleradiology may be an

optional choice in emergency rooms,^{7,8} it remains expensive in Japan and unreliable for lawsuits. When patients are admitted after examination in an emergency room, radiology reports are likely to be prepared the next day, and thus, attending physicians may only be able to confirm radiology findings the next day. However, when patients go home after an examination, it may sometimes be difficult to quickly diagnose the condition, because multiple physicians who ordered CT or MRI may also be unavailable. In such a situation, establishing a concrete system to confirm radiology reports after patients go home in emergency rooms is desirable.

Aizawa Hospital is an emergency and critical care center in the Matsumoto area of Japan (background population is approximately 400,000), and in addition to at least one certified full-time emergency doctor, several physicians participate in medical care in the emergency room. All radiology reports (CT or MRI) in the emergency room are managed by radiologists, and such a system is useful to prevent oversight by the emergency doctor. When radiology reports are unavailable, physicians consult with the certified emergency doctor and make a decision on whether or not the patient

Corresponding: Toru Koyama, MD, Department of Emergency and Critical Care Medicine, Aizawa Hospital, Aizawa Hospital, 2-5-1 Honjo, Matsumoto, Nagano 390-8510, Japan. E-mail address: aidr202@ai-hosp.or.jp.

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can go home. Historically, in this hospital, to confirm radiology (CT or MRI) report findings in the emergency room after patients have been discharged home, a certified emergency doctor of the next shift should analyze the radiology reports (with a permissible delay of half a day) and take care of patients who may need a change in treatment plans and subsequent corresponding procedures.

In this report, when patients go home after an examination in the emergency room, we studied the incidence or corresponding procedures of patients who needed a change in treatment plans after evaluation of radiology reports (CT or MRI) by emergency doctors, and the usefulness of inspection of radiology reports in the emergency room.

METHODS

FROM APRIL 2018 to March 2019, 34,269 patients were treated in the emergency room at Aizawa Hospital. In order to select patients who went home after examination, patients who were admitted, or transferred to other hospitals for further treatment, or died in the emergency room were excluded (Fig. 1). Among 27,413 patients who went home, patients who visited the emergency room with appointment, or visited the emergency room in the daytime for CT or MRI examinations, or with CT or MRI examinations ordered by medical specialists were excluded to select only

patients whose CT or MRI were ordered by emergency doctors for emergency treatment. Electronic charts of 5,917 patients who went home after CT or MRI ordered by emergency doctors in the emergency room were reviewed in analysis.

Of these patients, we investigated age, sex, number of CT or MRI per one patient (multiple CT or MRI were sometimes ordered for one patient), regions scanned by CT or MRI, rate of positive abnormal findings at each examination, reasons for requesting CT or MRI, incidence of patients who needed a change in treatment plans after inspection of radiology reports, and corresponding methods after change of treatment plans.

All radiology reports of CT or MRI in the emergency room were managed by radiologists, but when radiology reports were not available, especially at nighttime or holidays, a certified emergency doctor of next shift inspected radiology reports (with delay of half a day) and performed necessary corresponding procedures.

RESULTS

AMONG THE 5,917 patients who went home after CT or MRI ordered by emergency doctors in the emergency room, there were 3,082 men, 2,835 women, 2,745 patients aged 70 years or older, 2,734 patients were aged

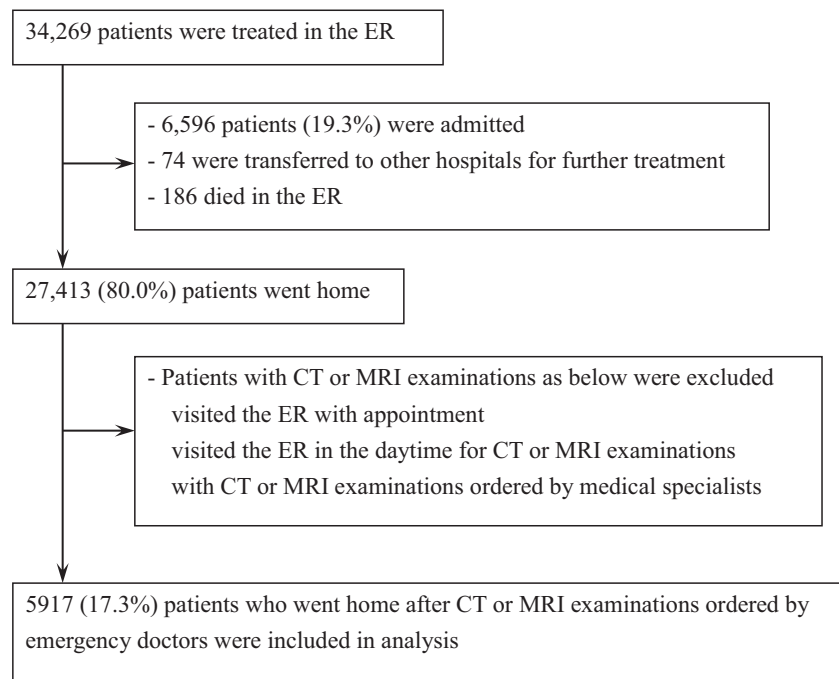


Fig. 1. Flow diagram of 5,917 patients who went home after computed tomography (CT) or magnetic resonance imaging (MRI) ordered by emergency doctors in the emergency room at Aizawa Hospital (Matsumoto, Japan). ER, emergency room.

Table 1. Summary of 5,917 patients, 7,661 CT (computed tomography) or MRI (magnetic resonance imaging), in the emergency room at Aizawa Hospital (Matsumoto, Japan)

Sex			
Male	3,082 (52.1%)		
Female	2,835 (47.9%)		
Age			
≥70	2,745 (46.4%)		
≤20 < 70	2,734 (46.2%)		
<20	438 (7.4%)		
Number of CT or MRI			
1	4,782 (80.8%)		
2	905 (15.3%)		
3	147 (2.5%)		
≥4	83 (1.4%): trauma 80, others 3		
Examinations (total 7,661)			
CT	7,008 (91.5%)	MRI	653 (8.5%)
Plain CT	6,116	Plain MRI	651
Head	2,943	Head	536
Face	434	Cervical spine	30
Neck	48	Thoracolumbar spine	47
Chest	937	Abdomen	4
Abdomen	1,182	Pelvis, hip joint	22
Cervical spine	373	Lower extremities	9
Thoracolumbar spine	53	Others	3
Pelvis, hip joint	54		
Upper extremities	27		
Lower extremities	63		
Others	2		
Enhanced CT	892	Enhanced MRI	2
Face	1	Head	2
Neck	10		
Chest	135		
Abdomen	720		
Pelvis	6		
Lower extremities	20		

under 70 but 20 or older, and 438 patients were aged under 20 (Table 1). The number of CT or MRI ordered per each patient was one in 4,782 patients, two in 905, three in 147, and more than 3 in 83. The average CT or MRI ordered was 1.3 and median was one. The number of total examinations was 7,661: 7,008 CT (6,116 plain and 892 enhanced) and 653 MRI (651 plain and 2 enhanced).

Among 6,116 plain CT, 2,943 were CT of the head, 434 of the face, 48 of the neck, 937 of the chest, 1,182 of the abdomen, 373 of the cervical spine, 53 of the thoracolumbar spine, 54 of the pelvis or hip joint, 27 of the upper extremities, 63 of the lower extremities, and 2 of the others (Table 2). Emergency doctors tried to confirm radiology

reports before patients went home, but the number of confirmed reports was not many.

Among the 892 enhanced CT performed, there were one of the face, 10 of the neck, 135 of the chest, 720 of the abdomen, 6 of the pelvis, and 20 of the lower extremities (Table 3).

Among the 651 plain MRI performed, there were 536 of the head, 30 of the cervical spine, 47 of the thoracolumbar spine, 4 of the abdomen, 22 of the pelvis or hip joint, 9 of the lower extremities, and 3 of the others (Table 4).

There were 131 patients (133 CT or MRI performed, i.e., 1.7% among the 7,661 examinations) who needed change of treatment plans and subsequent corresponding procedures

Table 2. Summary of 6,116 plain computed tomography (CT) in the emergency room at Aizawa Hospital (Matsumoto, Japan)

	Cases with abnormal findings	Confirmation made from RR before dismissal	Reasons for requesting CT
Head (2,943)	134	768	Headache (530) Dizziness (409) Transient LOC (237) Paresis, numbness (203) Somnolence, disorientation (128) Trauma (1,273) Others (278)
Face (434)	154	122	Trauma (402) Others (32)
Neck (48)	17	22	Cervical pain (12) Swelling (11) Trauma (7) Others (18)
Chest (937)	453	352	Chest pain (135) Fever (208) Cough, wheezing (118) Dyspnea (53) Trauma (331) Others (150)
Abdomen (1,182)	620	442	Abdominal pain (523) Back pain (171) Fever (77) Vomiting, diarrhea (53) Melena (24) Hematuria (23) Trauma (216) Others (152)
Cervical spine (373)	34	119	Trauma (340) Others (33)
Thoracolumbar spine (53)	28	29	Trauma (41) Others (12)
Pelvis, hip joint (54)	24	28	Trauma (39) Others (15)
Upper extremities (27)	15	14	Trauma (26) Others (1)
Lower extremities (63)	26	23	Trauma (55) Others (8)
Others (2)	2	2	Trauma (2)

LOC, loss of consciousness; RR, radiology report.

after inspection of radiology reports (Fig. 2, Table 5). Of the 133 examinations, there were 93 plain CT, 23 enhanced CT, and 17 plain MRI. Of the 133 examinations, there were 51 (38.3% among 133 examinations, 0.7% among 7,661 examinations) CT or MRI which included findings to suspect a tumor. There were six with head (one with multiple

brain metastasis and five with other benign tumors; 11.8% among the 51 examinations), 21 with chest (13 with lung nodules and 8 with others; 41.2%), 18 with abdomen (6 with hepatic or renal tumors and 12 with others; 35.3%), and 6 with others (5 with thyroid tumors and one with another; 11.8%).

Table 3. Summary of 892 enhanced computed tomography (CT) in the emergency room at Aizawa Hospital (Matsumoto, Japan)

	Cases with abnormal findings	Confirmation made from RR before dismissal	Reasons for requesting CT
Face (1)	1	1	Infection (1)
Neck (10)	6	7	Cervical pain (3) Swelling (3) Others (4)
Chest (135)	30	61	Chest pain, discomfort (72) Dyspnea, s/o PE (31) Trauma (11) Others (25)
Abdomen (720)	446	319	Abdominal pain (452) Back pain (50) Fever (23) Vomiting, diarrhea (30) Melena (39) Hematuria (8) Trauma (20) Others (120)
Pelvis (6)	3	3	Infection (3) Trauma (1) Others (2)
Lower extremities (20)	8	10	s/o DVT (13) s/o Arterial stenosis (4) Others (3)

DVT, deep vein thrombosis; PE, pulmonary embolism; RR, radiology reports; s/o, suspicious of.

Of the 133 examinations, consultation with medical specialist and observation were necessary for 72 examinations. With concerns to require important change of treatment plans, making an appointment for outpatient clinic was necessary for 52 examinations, and return to clinic or admission was necessary for 9 (totally 61, 0.8% among 7,661 examinations). Four patients were admitted; three needed admission and observation for internal carotid artery obstruction, paralytic ileus, and vertebral arch fracture of cervical spine, respectively. One patient needed emergency surgery for strangulation ileus. No patients had sequelae after important changes in treatment plans following inspection of radiology reports by emergency doctors,

DISCUSSION

AIZAWA HOSPITAL IS an emergency and critical care center in the Matsumoto area of Japan, and in addition to at least one certified full-time emergency doctor, several physicians, including night-duty doctors of internal medicine, general surgery, neurosurgery, and gynecology,

participate in emergency room medical care. CT or MRI managed by radiologists are limited especially at nighttime or holidays, and many Japanese emergency rooms may be in a similar situation. It is relatively easy to utilize CT or MRI in Japan, and if doctors do not use CT or MRI in emergency rooms and are involved in lawsuits, they are likely to lose their cases. There were several cases of law suits: for example, (i) a patient who complained of headache went home without head CT, but suffered subarachnoid hemorrhage and died (Saku Public Prosecutor's Office, 2008); (ii) a patient who complained of numbness around her mouth went home without head MRI, but suffered cerebral infarction and hemiparesis (Okayama District Court, 2005). Therefore, doctors in Japanese emergency room have no other choice but to order many CT or MRI to prevent lawsuits.

According to a report of the Japan Medical Safety Research Organization, 12 patients died in the last 3 years in emergency departments when their diagnostic imaging reports, such as CT, were overlooked (The Asahi Shimbun Digital, 2019). In this study, emergency fatal diseases, such

Table 4. Summary of 653 MRI in the emergency room at Aizawa Hospital (Matsumoto, Japan)

	Cases with abnormal findings	Confirmation made from RR before dismissal	Reasons for requesting MRI
Plain MRI (651)			
Head (536)	100	230	Headache (53) Dizziness (174) Transient LOC (15) Paresis, numbness (169) Somnolence, disorientation (40) Trauma (15) Others (83)
Cervical spine (30)	13	10	Pain, numbness (13) Trauma (8) Others (9)
Thoracolumbar spine (47)	20	28	Pain, numbness (37) Trauma (3) Others (7)
Abdomen (4)	2	3	Abdominal pain (4) Fever (2)
Pelvis, hip joint (22)	13	14	Trauma (17) Others (5)
Lower extremities (9)	5	4	Trauma (6) Others (3)
Others (3)	1	1	Shoulder pain (2) Others (1)
Enhanced MRI (2)			
Head (2)	1	1	Paresis, numbness (1) Others (1)

CT, computed tomography; LOC, loss of consciousness; MRI, magnetic resonance imaging; RR, radiology reports.

as subarachnoid hemorrhage, acute aortic dissection, rupture of aortic abdominal aneurysm, or pulmonary embolism, were not detected after patients went home. As a result, a certified full-time emergency doctor and several physicians including night-duty doctors could have possibly missed the diagnosis of these dangerous diseases.

When radiology findings raise the suspicion of a tumor, Suzuki et al. reported that the incidence rate of newly diagnosed cancer after visiting the emergency department was 0.86% among adult patients and 2.03% among patients aged 70 years or older.⁹ Of these patients, cancer was detected in the abdominal system (65%), respiratory system (13%), urinary system (10%), and others (13%). In our study, when inspection of radiology reports of CT or MRI by emergency doctors was performed after patients went home, there were 51 examinations which included findings to suspect a tumor (11.8% in head, 41.2% in chest, 35.3% in abdomen, and 11.8% in others). When compared with the report of Suzuki

et al., findings to suspect a tumor were detected more often not only in abdominal CT but also in chest CT. Detecting non-emergency abnormal findings to suspect a cancer is sometimes difficult. There were a few complex cases: for example, although findings to suspect a tumor were suggested by radiology reports, attending physicians could not confirm the finding and patients died later (The Asahi Shimbun Digital, 2018, Mainichi Newspaper 2019). In this study, 51 (0.7% among 7,661 examinations) CT or MRI findings raised the suspicion of a tumor. Although small lesions such as ground-glass opacities in lung CT or mucosal hypertrophy in abdominal CT are not always cancer, informing and following up patients with findings to raise the suspicion of a tumor are important to prevent lawsuits. We sometimes encounter CT or MRI findings to suspect a tumor in emergency rooms, and it is important to investigate the incidence or corresponding procedures of patients who needed a

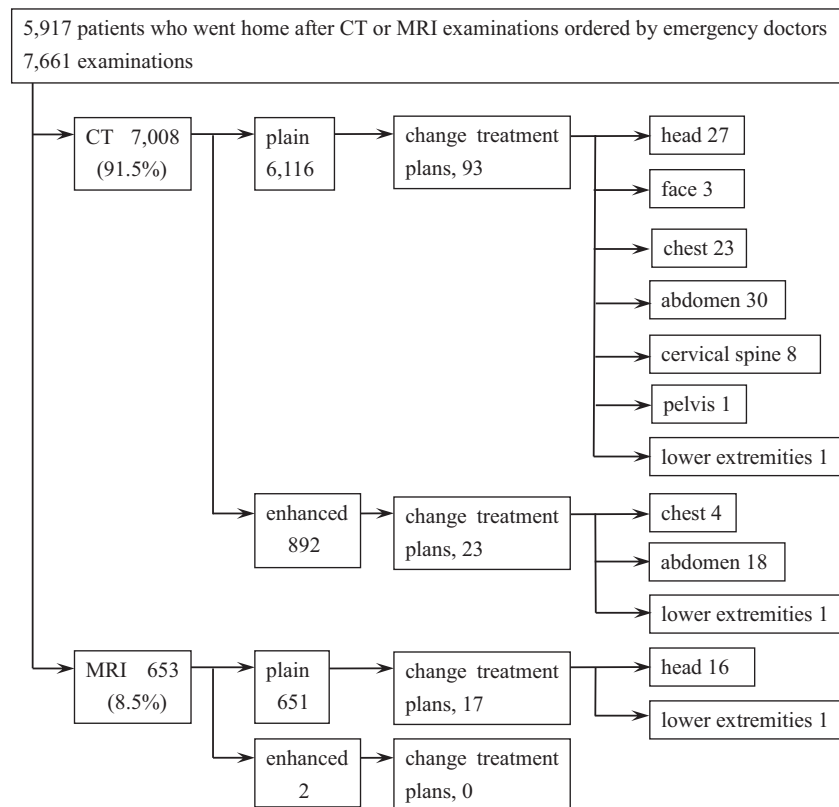


Fig. 2. Tree diagram of 131 patients, 133 computed tomography (CT) or magnetic resonance imaging (MRI), who required a change in their treatment plans after inspection of radiology reports by emergency doctors in the emergency room at Aizawa Hospital (Matsumoto, Japan).

change in treatment plans after inspection of radiology reports.

When radiology reports are unavailable, utilization of teleradiology may be an optional choice in emergency rooms.^{7,8} Saketkhoo *et al.*⁸ reported that 92% of emergency departments categorized as high-volume (with more than 25,000 visits per year) centers in the United States utilized teleradiology. However, the number of radiologists who are available especially at nighttime or on holidays is extremely limiting, and utilization of teleradiology is expensive in Japan (approximately US \$140,000 per year). In addition, it is unreliable for lawsuits.

Our trial has several limitations. Many emergency departments in Japan have similar systems to prevent missing CT or MRI findings. Therefore, it is desirable to report the descriptive statistics in nationwide survey for the emergency departments in Japan. However, this is the first report that describes missing rate of radiology reports of CT or MRI findings in an emergency room, and therefore, we cannot compare our data with those of others. In this scenario, we believe that it is useful to show the missing rate of CT or MRI findings in an

emergency room in order to make countermeasures to prevent further issues in making a reliable diagnoses.

In this report, the rate of positive abnormal finding on plain head CT was 4.6% and the rate of CT needed to change treatment plans was 0.9% among 2,943 plain head CT scans performed. The incidence of overlooking head CT scan findings in particular was low maybe because the incidence of abnormal findings on head CT is originally low.^{10–16} Further studies, for instance, on how many orders of CT or MRI can be reduced or what kind of clinical improvements is achieved by changing examinations, are expected.

CONCLUSION

IN this study, we investigated the incidence or corresponding procedures of patients who needed a change in treatment plans after inspection of radiology report of CT or MRI by emergency doctors after patients went home.

Findings to suspect a tumor were detected in 0.7%, and important changes in treatment plans were required in 0.8%

Table 5. Summary of 131 patients, 133 CT or MRI, who needed a change in treatment plans after inspection of radiology reports by emergency doctors in the emergency room at Aizawa Hospital (Matsumoto, Japan)

	Reason for change of treatment plans	Observation after consulting with MS [†]	Make appointment for OC [‡]	Patients return to clinic or AD
Plain CT (93)				
Head (27)	s/o HE or infarction (6)	4	1	1 (1 AD)
	s/o tumor (6)	3	3	
	Trauma (8)	7	1	
	Others (7)	1	6	
Face (3)	Fracture (3)	1	1	1
Chest (23)	Infection (3)	3		
	s/o Tumor (17)	10	7	
	Trauma (3)	3		
Abdomen (30)	Infection (6)	5		1
	s/o Ileus (4)			4 (2 AD)
	s/o Tumor (11)	5	5	1
	Vascular (2)		2	
	Others (7)	6	1	
Cervical spine (8)	s/o Thyroid tumor (5)	2	3	
	Fracture (3)	2		1 (1 AD)
Pelvis (1)	IP hematoma (1)	1		
Lower extremities (1)	Fracture (1)		1	
Enhanced CT (23)				
Chest (4)	s/o Tumor (4)	2	2	
Abdomen (18)	Infection (7)	4	3	
	s/o Tumor (7)	2	5	
	Vascular (2)	1	1	
	Others (2)	2		
Lower extremities (1)	DVT (1)	1		
Plain MRI (17)				
Head (16)	UR aneurysm (10)	3	7	
	s/o VB dissection (3)	1	2	
	Others (3)	3		
Thoracolumbar (1)	s/o Neurinoma (1)			1
Total (133)		72	52	9 (4 AD)

AD, admission; DVT, deep vein thrombosis; HE, hemorrhage; IP, intraperitoneal; MS, medical specialists; OC, outpatient clinic; UR, unruptured; s/o, suspicious of; VB, vertebrobasilar.

[†]“Call patient and observation” is included,

[‡]“Call patient and recommend follow-up” is included.

of the cases. The data suggest that introducing an inspection system of radiology reports by emergency doctors is useful to prevent finding oversight. It is important to establish a concrete system to confirm all radiology reports of CT or MRI after patients went home in emergency rooms.

DISCLOSURES

This study was approved by the ethical review board at Aizawa Hospital (No. 2019-031, R1-9).

Conflict of Interest: None declared.

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