



Evaluation of Challenges in the Diagnosis of Spinal Injury Complicated with Trauma

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Abstract

Introduction: Spinal injury is often complicated with severe and multiple traumatic injuries. However, a diagnosis of Spinal injury can be difficult without available neurological findings. We examined spinal injury patients with trauma and investigated challenges in diagnosis and treatment.

Patients and Methods: Of 8,154 cases with trauma that presented to our center between October 01, 2012 to September 30, 2015, 118 were spinal injury. Of these 118 cases of spinal injury, neurological findings were not obtained in 19 cases. Here, we investigated the reasons for being unable to diagnose these cases as spinal injury.

Result: In all 19 cases, we were unable to obtain neurological findings due to disturbance of consciousness. Disturbance of consciousness was due to shock in 8 cases, head injury in 4 cases, patient psychiatric background in 3 cases, hypothermia in 2 cases, out of hospital cardiopulmonary arrest in 3 cases, and intoxication in 1 case. Diagnosis of vertebral fracture and spinal injury was obtained by computed tomography images at the first medical examination in 17 of the 19 cases. In 1 case not diagnosed at the first medical examination, disturbance of consciousness was due to accidental hypothermia and shock. Paralysis was observed after consciousness recovery, and spinal cord injury was diagnosed by magnetic resonance imaging.

Conclusion: In the emergency room, attention should be given to patients with disturbance of consciousness and severe multiple injuries to consider a diagnosis of spinal injury.

Keywords: Trauma; Spinal injury; Spinal cord injury; (SCIWORA) Spinal Cord Injury Without Radiographic Abnormality; Disturbance of consciousness; Emergency room

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Introduction

Spinal injury is often complicated with severe and multiple traumatic injuries. Thus, it is important to examine the spine closely for injury at the time of first medical examination in patients with multiple injuries. Injury to the spine can result in spinal cord injury through in appropriate treatment at the time of first medical examination or conveyance, which can worsen the general status of the patient and the function prognosis. However, a diagnosis of spinal injury may become difficult when neurologic findings cannot be obtained. In particular, Spinal Cord Injury without Radiographic Abnormalities (SCIWORA) that cannot be diagnosed by Computed Tomography (CT) imaging is likely to be missed. Here, we examined spinal injury patients with severe injury that were admitted to our center, and evaluated challenges in diagnosis and treatment.

Patients and Methods

Of 8,154 cases with trauma that presented to our center between October 1, 2012 to September 30, 2015, 118 were spinal injury. Of these 118 cases of spinal injury, neurological findings were not obtained in 19 cases, and we investigated the reasons for being unable to diagnose these cases as spinal injury.

Results

In all 19 spinal injury cases, we were unable to obtain neurological findings due to disturbance of consciousness. Table 1 lists the cause of disturbance of consciousness and the diagnosis of all 19 cases. The cause of disturbance of consciousness was hemorrhagic or cardiogenic shock in 8 cases, head injury in 4 cases, patient psychiatric background in 3 cases, hypothermia in 2 cases, out of hospital cardiopulmonary arrest in 3 cases, and intoxication in 1 case. Mechanism of injury was the fall in

Table 1: Characteristics of the 19 cases without neurological findings after severe injury.

No.	Age	Sex	The cause of disturbance of consciousness	Diagnosis	※
1	78	M	Hemorrhagic shock	Thoracolumbar multiple chance fracture (Th4-L3), Cerebral contusion, Acute extradural hematoma, Facial fracture, Multiple rib fracture, Traumatic hemopneumothorax, Liver injury	+
2	76	M	Hemorrhagic shock	Cervical spine fracture (C3/4), Cervical cord injury (C3/4), Head injury	+
3	66	M	Cardiogenic Shock	Atlantoaxial dislocation fracture (C1/2), Traumatic diaphragm injury	+
4	54	M	CPA	Atlantoaxial dislocation fracture (C1/2)	+
5	28	F	Schizophrenia	Thoracolumbar multiple compression fracture (Th11-L1), Thoracolumbar multiple chance fracture (Th4-12), Clavicle fracture	+
6	35	M	Head injury	Atlantoaxial dislocation fracture (C4/5), Acute epidural hematoma, Skull fracture	+
7	65	M	Hypothermia	Atlantoaxial dislocation fracture (C7), Cervical cord injury (C7), Cerebral contusion	+
8	22	F	Schizophrenia	Cervical vertebral body and arcus vertebrae fracture (C6), Thoracic vertebral body, arcus vertebrae and chance fracture (Th2-10), Traumatic pneumothorax	+
9	29	F	Developmental disorder, Mental retardation	Lumbar vertebrae burst fracture (L1), Pelvic fracture, Tibiofibular fracture	+
10	53	M	Head injury	Cervical vertebral body fracture (C7), Multiple rib fracture, Clavicle fracture, Traumatic hemopneumothorax, Liver injury, Cerebral contusion	+
11	64	F	Hypothermia, Shock	SCIWORA (C5/6, 6/7), Cervical spinal column stenosis	-
12	75	M	Head injury, Hemorrhagic shock	Atlantoaxial dislocation fracture (C1/2), Pelvic fracture, Cerebral contusion, Acute subdural hematoma, Brachiocephalic trunk and internal thoracic artery injury, Traumatic hemopneumothorax, Multiple rib/clavicle fracture	+
13	45	M	CPA	Cervical vertebrae spinous process fracture (C4), Right cervical arcus vertebrae fracture (C5), Hypoxic encephalopathy	+
14	67	M	CPA	Anterior arch of atlas fracture, Cervical vertebrae spinous process fracture (C7), Odontoid fracture, Hypoxic encephalopathy	+
15	8	F	Hemorrhagic shock	Atlantoaxial dislocation fracture (C1/2), Diffuse cerebral contusion, Traumatic subarachnoid hemorrhage, Lung injury, Multiple rib fracture, Bilateral hemopneumothorax, Left kidney injury, Subcapsular liver injury, Pelvic fracture, Left leg non-compound fracture	+
16	22	M	Hemorrhagic shock	Lumbar vertebrae burst fracture (L1), Lumbar vertebrae spinous process fracture (L1-2), Unstable pelvic fracture, Liver injury, Abdominal compartment syndrome, Right traumatic hemopneumothorax, The fourth and fifth right rib fracture, Bilateral lower extremity fracture	+
17	68	M	Drunkenness	Lumbar vertebrae transverse process fracture, Stable pelvic fracture, Traumatic hemopneumothorax, Lung and Kidney injury, Cerebral contusion, Acute subdural hematoma	+
18	81	M	Head injury	Thoracic vertebral body fracture (Th1), Pelvic fracture, Cerebral contusion, Acute subdural hematoma, Traumatic subarachnoid hemorrhage	-
19	83	M	Hemorrhagic shock	Lumbar vertebral body burst fracture (Th12), Left hip dislocation fracture, Cervical/Thoracic/Lumbar vertebral body fracture (C6, Th11, L1), Traumatic liver injury, Facial fracture	+

※: Possible(+) or impossible(-) diagnosis at initial examination

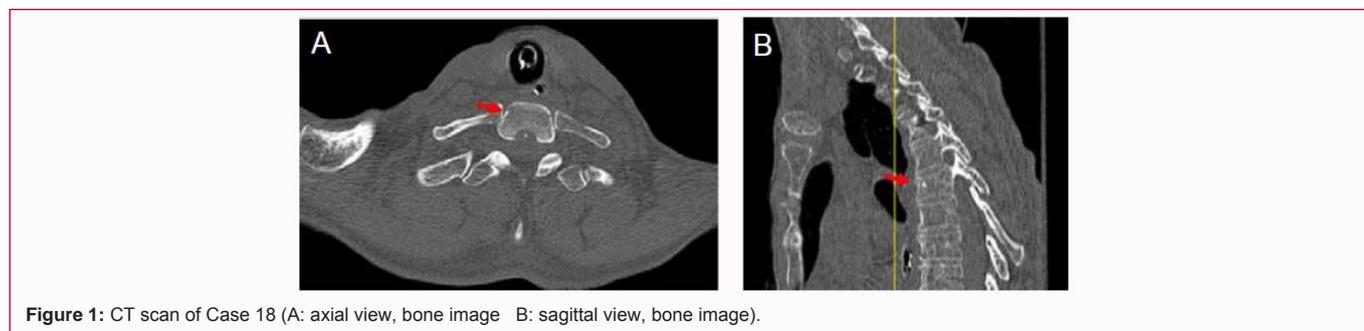


Figure 1: CT scan of Case 18 (A: axial view, bone image B: sagittal view, bone image).

6 cases, traffic accident in 7 cases, toppling in 2 cases, the remainders were unknown. Four of six cases of the fall are suicide attempts. Cases 11 and 18 were not diagnosed as spinal injury at the time of first medical examination. Except for these two cases, a diagnosis of vertebral fracture and SCI was possible by CT at the time of the first medical examination. Case 11 (reported previously by Kanezaki et al. [1]) was a 64-year-old female [1]. The patient was found to be severely hypothermia with a rectal temperature of 24.6°C. Her Glasgow Coma Scale was 9 (E2V3M4). We managed her treatment in the Intensive Care Unit (ICU). She became lucid at 6 days after admission, but, at this time, tetraplegia was observed. Using Magnetic Resonance Imaging (MRI), we observed a high intensity area in the spinal cord. We diagnosed Case 11 as SCIWORA. Case 18 was an 81-year-old male. During a walk, he was hit by a car and thrown approximately 10 m. He was conveyed to the nearest hospital, and acute subdural hematoma was observed on CT. At this time, Case 18 was moved

to our hospital. On arrival at the emergency room of our hospital, the patient was intubated and assisted in ventilation by a respirator. His Glasgow Coma Scale was 3 (E1VTM1). His vital signs showed no abnormalities, and heart rate 90 bpm, blood pressure 113/34 mmHg, respiratory rate 16 bpm, SpO₂ 95%, temperature 37.6°C. He did show left pupil mydriasis, anisocoria, and decerebrate posture. We observed an increase in his hematoma on CT, and proceeded with urgent single burr hole surgery. After surgery, his disturbance of consciousness improved from E1 to E2. Before we performed CT again, we detected a thoracic vertebral body (Th1) fracture by radiologist's report (Figure 1) at 2 h after admission at our hospital.

Discussion

In one of the cases (Case 11), spinal cord injury was overlooked at the time of the first medical examination, and was diagnosed after hospitalization as SCIWORA. SCIWORA was first defined as objective

signs of acute traumatic myelopathy in the absence of spinal column findings on plain radiographs, flexion-extension radiographs, and/or CT [2]. Hendy et al. [3] reported 818 patients (2.4%) with spinal injury of 34,069 trauma patients. Of the 818 spinal injury patients, 27 patients (0.08% of the total patients and 3.3% of the SCI patients) were diagnosed as SCIWORA [3]. Kato et al. [4] reported that most SCIWORA injuries occur in older patients involve minor, low-energy mechanisms, while SCIWORA injuries in younger patients generally involve high-energy mechanisms [4].

In Case 11, the patient showed no clear abnormality by head and cervical CT. Thus, we considered the likelihood of a cervical cord injury at initial treatment to be low. In addition, since there was no clear trauma above the neck, we did not consider MRI as warranted. Schoenfeld et al. [5] reported in a meta-analysis of 11 prospective studies that MRI identified 182 patients with cervical spine abnormalities, of which 86 showed ligamentous injuries; among 1,550 patients whose initial CT scan of the cervical spine was negative [5]. MRI is useful for the diagnosis of SCIWORA. If cervical cord injury is suspected, an MRI should be considered even if CT was negative. In our Case 11, we did not consider protecting the patient's neck in the ICU. The tetraplegia was improved by rehabilitation, and the patient returned to everyday life. However, our management of the case was critical for the outcome. Until no spinal cord injury is confirmed, cervical vertebrae protection should be required after ICU admission.

In our other spinal injury case (Case 18) that was not diagnosed at first medical examination, a thoracic vertebral fracture on CT was not observed immediately. During the physical examination, we set our attention to the CT results of the head. Thus, we did not notice a dorsal body fracture of the thoracic vertebra until the radiologist report was completed at 2 h after admittance. We were not able to examine the image closely because his poor status. In cases of poor patient status, we often perform MRI. In similar cases, it is important to examine the patient imaging closely.

Conclusion

Disturbance of consciousness in patients with trauma could inhibit obtaining neurological findings. We identified 2 cases in which a definitive diagnosis of vertebral fracture and spinal cord injury were not observed in CT at the time of the first medical examination. SCIWORA should be suspected, because MRI may not be performed at the time of the first medical examination. Until spinal cord injury has been assessed completely, cervical vertebrae protection is necessary after ICU admission.

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