Case Report

# Tetraparesis due to spinal cord injury without radiological abnormality in adults

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## ABSTRACT

**Introduction:** Spinal cord injury without radiological abnormality (SCIWORA) is definedas spinal cord injury with no evidence of vertebral fractures or malalignment on radiographs or CT**.**SCIWORA is commonly seen in paediatric population, while only very few cases have been reported in adults.We report a case of SCIWORA to improve our understanding regarding the pathophysiology of SCIWORA, current diagnostic options, and also treatment options available.

**Methods:** We report a case of a 49 year old male with tetraparesisafter fell from 3 meters height. Physical examination founddecreased sensation below the C5 dermatome level, with motoric weakness at both upper and lower extremities. Radiographs and CT showed no fractures or dislocation. MRI suggested that there was myelitis of intramedullary spinal on the C4 level. Conservative treatment was done by using hard collar neck for immobilization together with painkiller and neuroprotector administration.

**Results:** Spinal trauma patients exhibitingneurological deficit but no radiological abnormality should be treated as a case of SCIWORA. SCIWORAis caused by a contusion or ischemia, followed by a spontaneous return of vertebrae to their original position.The principal treatment has been immobilization and avoidance of high-risk activities.The conservative treatment that was done to our patient gave satisfying outcomes (return of sensorics and improve motor functions 4/4).

**Conclusion:**SCIWORA is not uncommon in adults.MRI was used as a diagnostic investigation method for spinal trauma, but there are currently no consensus of diagnostic criteria for classifying cases as SCIWORA. External immobilization of the spinal segment of injury is recommended for up to 12 weeks.

## ABSTRAK

***Pendahuluan:*** *Spinal cord injury without radiological abnormality (SCIWORA) didefinisikan sebagai kasus cedera tulang belakang dimana tidak ditemukan adanya fraktur vertebra atau malalignment pada radiografi atau CT scan. SCIWORA lebih sering dilaporkan terjadi pada populasi anak. Sangat sedikit kasus SCIWORA yang dilaporkan pada populasi orang dewasa. Kami melaporkan satu kasus SCIWORA untuk meningkatkan pemahaman mengenai patofisiologi kondisi ini, pilihan diagnostik yang dapat digunakan, serta pilihan tata laksana yang dapat dilakukan.*

***Metode:*** *Kami melaporkan laki-laki usia 49 tahun dengan tetraparesis setelah terjatuh dari ketinggian ± 3 m. Pada pemeriksaan fisik ditemukan penurunan sensasi pada level dermatom C5 ke bawah, dan penurunan kekuatan motorik pada ekstremitas atas (2/2) dan bawah (3/3). Tidak ditemukan kelainan pada pemeriksaan radiografi dan CT scan. Pada pemeriksaan MRI ditemukan adanya myelitis di intramedula spinalis setinggi level C4. Pada pasien ini dilakukan terapi konservatif dengan penggunaan hard collar neck untuk immobilisasi, pemberian penghilang nyeri dan neruprotektor.*

***Hasil:*** *Pasien dengan riwayat cedera tulang belakang dengan deficit neurologis namun tidak ditemukan kelainan radiologis harus dianggap sebagai kasus SCIWORA. Kondisi ini terjadi akibat kontusio atau iskemia yang diikut idengan kembalinya vertebrae ke posisi semula. Tata laksana utama pada kasus ini adalah dengan imobilisasi dan menghindari aktivitas risiko tinggi. Terapi konservatif yang diberikan pada pasien ini memberikan hasil yang memuaskan (kembalinya fungsi sensorik dan peningkatan motoric 4/4).*

***Kesimpulan:*** *SCIWORA tidak jarang terjadi pada orang dewasa. MRI digunakan sebagai metode diagnostik untuk trauma tulang belakang, namun belum ada konsensus untuk mengklasifikasikan kasus sebagai SCIWORA. Imobilisasi eksternal pada segmen yang cedera direkomendasikan selama 12 minggu.*

Keywords: SCIWORA, adult, tetraparesis, MRI, radiography, external immobilization

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## INTRODUCTION

The term spinal cord injury without radiological abnormality (SCIWORA) was first described by Pang and Wilberger in 1982. They used this term and define it as clinical symptoms of traumatic myelopathy with no radiographic or computed tomographic features of spinal fracture or instability.[1]With the emergence of magnetic resonance imaging (MRI),occult damage in the soft tissues of the spine and the patterns of the cord in SCIWORA have been revealed. Nonetheless, this acronym is still used when the spinal cord injury is not identifiable byroutine radiograph or CT scan, and by considering that MRI in the strict scientific sense does not involve radiation.[1–3] SCIWORA is commonly seen in paediatric population with reported incidence ranges from 4 to 66%. The prevalence is the highest among children below 8 years of age who also have the most unfavorable prognosis, which is possibly related to therelatively heavy head, weaker neck muscles and greater elasticity of vertebral ligaments in this patient population.[4,5]Very few cases of SCIWORA have been reported in adult population and majority of these cases are in cervical spine.[3,5,6]We reporta case of SCIWORA to improve our understanding regarding the pathophysiology of SCIWORA, current diagnostic options that couldbe used to investigate this clinical-radiological condition, and also the treatment options available.

## CASE ILLUSTRATION

We report a49 year oldmale that came to our hospital with chief complaint of weakness of both upper and lower extremitiesfor the last 3 days before hospital admission. The patient fell from an about 3-meter heighttree. He fell in sitting position with his buttock hit the ground first, then his head hit the tree with unknown mechanism. After the fall, he feltweakness inhis both upper and lower extremities. There was no history of loss of consciousness, seizures, vomiting, previous neurological disorder,or bleeding coming from his body.

Physical examination revealed that there were no deformities or wound (Figure 1).
There was diffuse tenderness at the cervical vertebral level. There was decreased sensation below theC5 dermatome level. Motor strength as per MRC (medical research council) grading in the upper limb was 2/2, while in both of the lower limbs was 3/3. We found normal bladder and bowel functions. Deep and superficial tendons reflexes were present in bilateral lower limbs. The rest of the systemic examination was unremarkable. There was no evidence of any other musculoskeletal injuries.

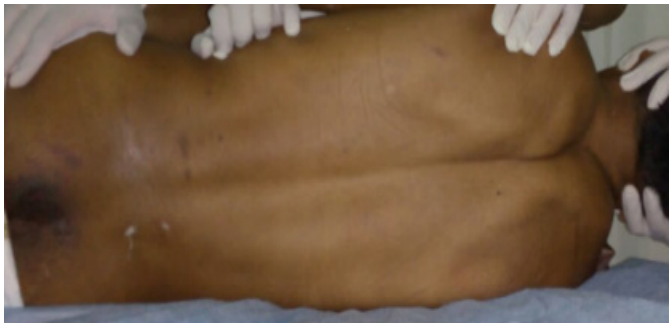

**Figure 1**. Clinical picture showing the back of the patient

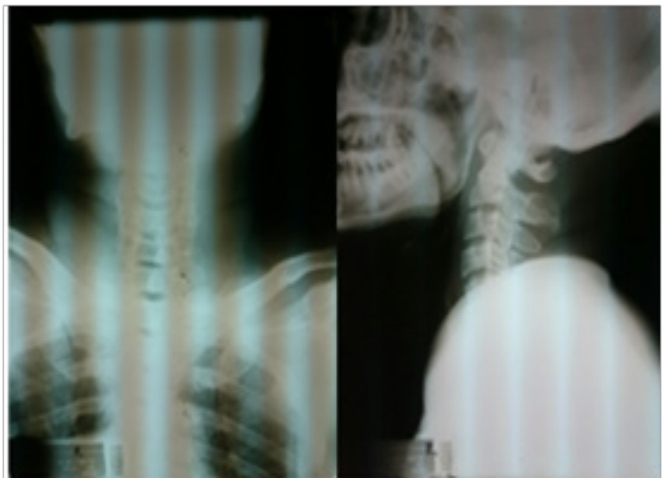

**Figure 2.** X-ray images of the cervical spine PA and the lateral view.

Laboratory findingswere unremarkable.Radiographic examination of the cervical spine (Figure 2) was carried out, but there were no significant radiological findings correlated to the clinical examination. Computerized tomography (CT) Scan of the cervical spine was performed, showing no fracture and dislocation (Figure 3). Magnetic resonance imaging of the cervical spine showed hyperintense lesions in the spinal cord at the C4 vertebrae on T2 weighted images suggestingthat there was myelitis of intramedullary spinal on the C4level (Figure 4).

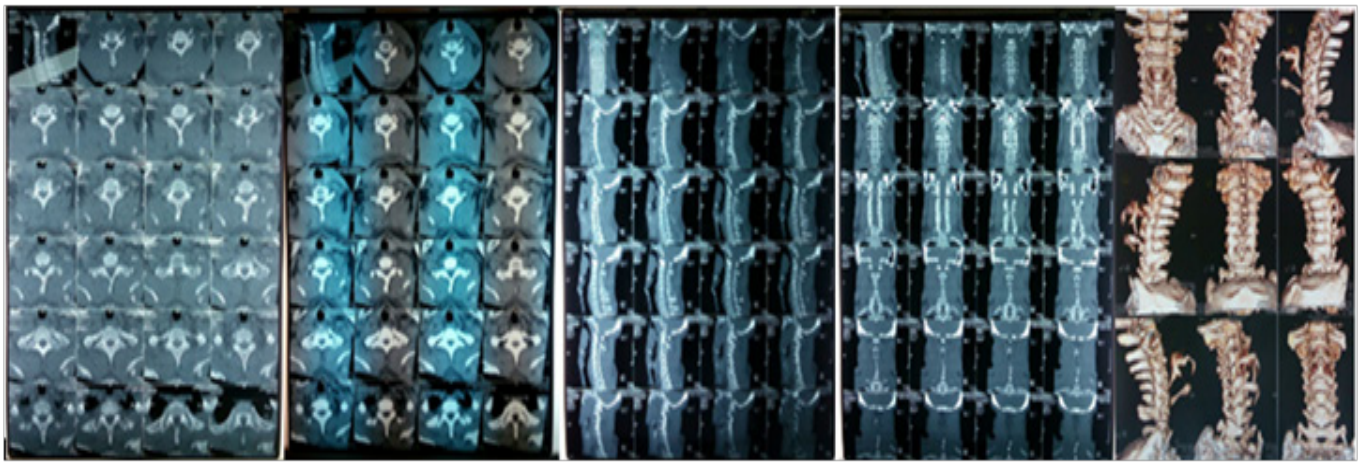

**Figure 3.** CT scan image of cervical spine

**Figure 4.** MRI of cervical spine

## RESULTS

We diagnosed this patient with tetraparesis due to spinal cord injury without radiological abnormality. We manage the patient with complete bed rest and the cervical vertebrae were immobilized by using hard collar neck.We also gave NSAID (Ketorolac 3x30 mg) and methylcobalamin 3x500 mg. Sensory function was improved in 10 days after the injury. The patient regained hismuscle strength with MRC grade of 4/4for both the upper and lower extremities at 6 weeks following the injury. After 6 weeks, the external immobilizer was discontinued. His last follow up was at 6 months after theinjury and there were no further muscular or sensory improvements.

## DISCUSSION

In this report, we present a case of a 49 year oldmale with tetraparesis due to SCIWORA. SCIWORA is characterized by acute traumatic myelopathy in spite of normal plain radiographs and computed tomographic studies. SCIWORAis more common in children than in adults and represents a significant percentage of paediatric spinal cord injuries.[1,7] Another literature mentioned that SCIWORA is responsible for 6 to 19% in children, and 9% to 14% in adults.[5]In one series, SCIWORA was diagnosed in 32% of children from birth to 8 years of age with spinal injuries, and in 16% of children from birth to 16 years old.[8] The difference in the incidence rate betweenthese two age groups is due to anatomic reasons: children under 8 years are particularly susceptible to SCIWORA probably associated with the relatively heavy head, weaker neck muscles and greater elasticity of vertebral ligaments in this patient population. More horizontal orientation of the facet joints increases further the susceptibility to these injuries. Specific biomechanics of the vertebral column in children allows the musculoskeletal system to move beyond the normal physiological range of motion without the risk of fracture.[1,2,8] The injury to the spinal cord is caused by a contusion or ischemia due to momentary occlusion of vertebral arteries followed by a spontaneous return of the vertebrae to their original position.[3,5,6]

In the majority of cases, SCIWORA occurs as a result of hyperextension forces or from a direct frontal impact to the face. In the elderly, however,the casesare most often associated with low-energy falls. Adult patients usually present with underlying degenerative changes, including spondylosis or spinal canal stenosis. The level of spinal cord injury corresponds to the location of these changes, which may suggest that degenerative spine conditions predispose to SCIWORA injuries. Even minor hyperextension injury can trigger a central cord syndrome in patients with spinal stenosis. Neurological deficit that is more severe in the upper extremities than in the lower extremities is the most typical clinical presentation in patients with SCIWORA. Spinal cord compression and impingement could be caused by both bone spur growth at the posterior margins of vertebral bodies and bulging of the yellow ligament from the back side into the spinal canal.[3] Venous congestion within the compressed spinal cord is theother pathogenic factor.[6]The onset of clinical symptoms is delayed from a few minutes to 48 hours after injury in about 50% of patients. This latency is associated with repeated micro-insults to the spinal cord from striking against the unstable vertebrae.[3,5,6]

Assessments of spine injury should include clinical examination, especially neurological examination. Patients diagnosed with SCIWORA have a broad spectrum of neurological deficits, from mild symptoms such as paresthesia in fingers to quadriplegia. Some patients experience symptoms only at the moment of injury. When performing physical examination, it is important to bear in mind that neurological deficits may only become apparent after several days of injury. Since physical examination is limited, clinicians mainly rely on the diagnostic imaging when planning the treatment for these patients.[2,7,9]

Conventional X-rays are performed as thefirst-line imaging test. A lateral spine X-ray can identify 75%of fractures with sensitivity of 85%. Anteroposterior (AP), lateral, oblique andopen mouth or odontoid radiographs should also be taken. The stabilityof the cervical spine can also be assessed by flexion andextension dynamic radiographs. However, it should be notedthat plain X-rays provide inconclusive evidence in patientswith post-traumatic cervical dystonia, so this treatmentshould bepostponed until complete resolution of muscle spasm.[5,7]Computed tomography is the most accurate in detecting bonypathology. CT scan can be used to visualize subtle injuriesto the posterior arch or lateral mass of the vertebra,and injuries to the atlas, and odontoid process that are poorlyvisible in standard X-rays.[5,9]

When a diagnosis of spinalfracture can be excluded from the results ofX-rays and CT scan, SCIWORAshould

be suspected and MRI should be performed in patients with blunt trauma injuriesand neurologic deficits. Radiographic screening of the entire spinal column is recommended.[9]MRI is useful not only for investigating soft tissue abnormalities, but it also allows for the identification of bone marrow edema ininjured vertebrae that cannot be seen in CT scan.[5]

The integrity of the spinal cord can be clearly ascertained in sagittal plane. The main symptoms ofan acute spinal cord injury (SCI) include edema, hematoma,anatomic transection of the spinalcord, and prolapsed nucleus pulposus. Magnetic resonance imagingis effective not only for investigating soft tissue abnormalities, but it also allows for detection of bone marrow edema ininjured vertebrae that cannot be seen in CT scan.T1 MR images provide information about the morphologyand anatomy of the spinal cord. Bleeding can be best identified inT2-weighted images. An increase in theconcentration of deoxyhemoglobin in fresh hematomacauses a decrease in signal intensity in T2WI. In abouta week or more later, hematoma isformedandhyperintense is seenin T1 and T2WI. However,in chronic phase, hemorrhages will look hypointense againin T2WI dueto the presence of hemosiderinladen macrophages. Spinal cord edema is seen as hyperintensesignal in T2WI, in contrast withthebackground ofnormal nervous tissues.Radiological features of the post-traumatic disc herniationare similar to those of non-traumatic. Therefore,it is often almostimpossible to identify the differencebetween the two forms of disc prolapse. Only the presenceof other post-traumatic lesions at the same level may imply probable diagnosis.[5,7,9]MRI provide prognostic information regarding the long-term neurological outcomes in patients with SCIWORA. Myelography and angiography have no defined role in the evaluation of patients with SCIWORA.

In SCIWORA, there are no subluxation or malalignment, therefore the principal treatment has been immobilization and avoidance of activitiesthat may either lead to the exacerbation of the present injury or the increase in the potential for injury recurrence. Pang and Pollackrecommended the use of external immobilization for 12 weeks to allow an adequate time for healing of the presumed ligamentous strain/injury, and to prevent exacerbation of the myelopathy.[5]However the role of immobilization is still unclear concerning that dynamic X-rays have displayed no instability. The time period and even the need for immobilization is remain debatable.[10]Early discontinuation of external immobilization is advised for patients who become asymptomatic and for patients whose spinal stability have beenconfirmed with flexion and extension radiographs. High-risk activities should be refrained for up to 6 months.Some studies had included steroids as part oftheir treatment along with bed rest. The use of steroids isnot supported by substantial evidence in these cases.[7] In our patient, we gave NSAID (Ketorolac 3x30 mg) to alleviate pain and also to suppress the inflammation. We also gave methylcobalamin 3x500 mg, with expectation that it will exerts neuronal protection by promoting regeneration of the injured nerves and antagonizing the glutamate-induced neurotoxicity

The outcomesforpatients with SCIWORA arevaried, which correspondsto the severity of the injury. The spinal cord signal changes have prognostic valuesfor the recovery from injury. Some studies suggested that MRI abnormalities (or lack of abnormalities) of the cord was more predictive than presenting the neurological status. On the other hand, children have been documented to have recurrent SCIWORA (13), and predictors for “high-risk” subgroup of children with SCIWORA for recurrent injury may exist.The treatment outcomesareworst in patients with cord disruption, poor in patients with haemorrhage and good in patients with edema or normal cord.[10] However, recurrent cases of SCIWORA has been documented, and predictors for “high-risk” subgroup of patients with SCIWORA for recurrent injury may exist.

## CONCLUSION

The incidence of SCIWORA is not uncommon in adults, there is an increasing number of SCIWORA cases in adults that are being reported in the literature. Routine radiographs, and sometimes even computerized tomography, can miss this injury and SCIWORA should be suspected in these cases of spinal injury presenting with neurological involvement. Ourpatient fulfilled the definition of SCIWORA.In ourpatient, physical examination correlatedwell with the MR imaging findings, without abnormalities in radiographic. The patient was treated conservatively with collar neck as an external immobilization for a good prognosis.

## Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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