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Clinical algorithm for preventing missed diagnoses of occult cervical spine instability after acute trauma: A case report

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Abstract

BACKGROUND

Missed or delayed diagnosis of cervical spine instability after acute trauma can have catastrophic consequences for the patient, resulting in severe neurological impairment. Currently, however, there is no consensus on the optimal strategy for diagnosing occult cervical spine instability. Thus, we present a case of occult cervical spine instability and provide a clinical algorithm to aid physicians in diagnosing occult instability of the cervical spine.

CASE SUMMARY

A 57-year-old man presented with cervical spine pain and inability to stand following a serious fall from a height of 2 m. No obvious vertebral fracture or dislocation was found at the time on standard lateral X-ray, computed tomography, and magnetic resonance imaging (MRI). Subsequently, the initial surgical plan was unilateral open-door laminoplasty (C3-7) with alternative levels of centerpiece mini-plate fixation (C3, 5, and 7). However, the intraoperative C-arm fluoroscopic X-rays revealed significantly increased intervertebral space at C5-6, indicating instability at this level that was previously unrecognized on preoperative imaging. We finally performed lateral mass fixation and fusion at the C5-6 level. Looking back at the preoperative images, we found that the preoperative T2 MRI showed non-obvious high signal intensity at the C5-6 intervertebral disc and posterior interspinous ligament.

CONCLUSION

MRI of cervical spine trauma patients should be carefully reviewed to detect disco-ligamentous injury, which will lead to further cervical spine instability. In patients with highly suspected cervical spine instability indicated on MRI, lateral

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X-ray under traction or after anesthesia and muscle relaxation needs to be performed to avoid missed diagnoses of occult cervical instability.

Key Words: Clinical algorithm; Missed diagnoses; Occult cervical spine instability; Case report

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Core Tip: Currently, there is no consensus on the optimal strategy for diagnosing occult cervical spine instability. We present a case of occult cervical spine instability and provide a clinical algorithm for diagnosing occult instability of the cervical spine. In this clinical algorithm, we recommend bedside lateral X-ray under traction or lateral X-ray after anesthesia and muscle relaxation prior to surgery as an effective, safe, and efficient method for detecting highly suspected instability of the cervical spine. We believe that this clinical algorithm will aid physicians in preventing missed diagnoses of occult instability of the cervical spine.

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INTRODUCTION

Cervical spine instability can result from injury to vertebral bone, intervertebral disc or ligament, or other soft tissue. Investigating cervical spine instability after acute trauma is important. Missed or delayed diagnosis can have catastrophic consequences for the patient, resulting in severe neurological impairment[1,2]. Multiple radiological techniques are used to evaluate the stability of the cervical spine, such as X-ray, computed tomography (CT), and magnetic resonance imaging (MRI). Currently, however, there is no consensus on the optimal strategy for diagnosis of occult cervical spine instability. Only a few cases have been reported in the literature regarding the diagnosis and treatment of unrecognized cervical spine instability[3-5]. Here, we present a case of occult cervical spine instability and provide a clinical algorithm to aid physicians with diagnosis of occult instability of the cervical spine.

CASE PRESENTATION

Chief complaints

A 57-year-old man presented with cervical spine pain and inability to stand following a serious fall from a height of 2 m.

History of present illness

The patient had no prior history with regard to the lesion.

History of past illness

The patient had no specific history of past illness.

Personal and family history

The patient had no known personal or family medical history.

Physical examination

Physical examination revealed cervical spine tenderness and neurological deficits. He had grade 2/5 muscle strength in his right upper extremity and grade 0/5 muscle strength in his other extremities. He also had dysesthesia below bilateral C5 dermatomes.

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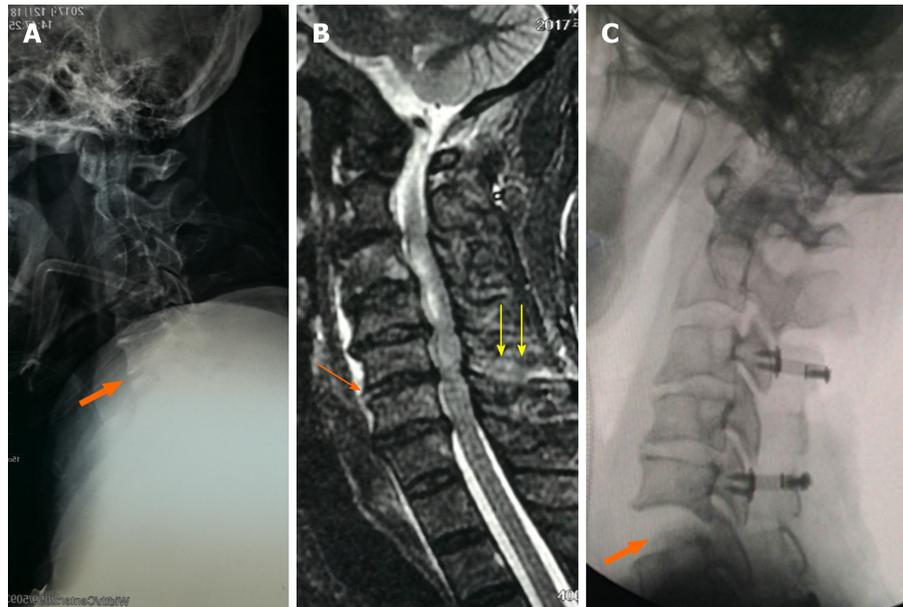


Figure 1 A case of occult cervical spine instability. A: The standard lateral X-ray at admission showed no obvious instability of the cervical spine; B: The magnetic resonance imaging at admission showed injuries involving the disc (orange arrow) and posterior interspinous ligament (yellow arrows) at the C5-6 level; C: The intraoperative C-arm fluoroscopic X-ray after anesthesia and muscle relaxation revealed significantly increased intervertebral space at C5-6, indicating instability at this level.

Laboratory examinations

All ordered laboratory tests (complete blood count, basic metabolic panel, lipid panel, liver panel, coagulation tests, urinalysis, and stool analysis) were normal.

Imaging examinations

No obvious vertebral fracture or dislocation was found at the time on standard lateral X-ray, CT, and MRI (Figure 1A and B). No other injuries or comorbidities were found.

FINAL DIAGNOSIS

The patient was diagnosed with hyperextension injury of the cervical spinal cord and cervical spinal canal stenosis.

TREATMENT

The initial surgical plan was unilateral open-door laminoplasty (C3-7) with alternative levels of centerpiece mini-plate fixation (C3, 5, and 7). However, after the above procedures were completed, intraoperative C arm fluoroscopic X-rays revealed significantly increased intervertebral space at C5-6, indicating instability at this level (Figure 1C) that was previously unrecognized on preoperative imaging. Therefore, after obtaining consent from the patient's family, we removed the centerpiece mini-plate on C5 and then performed lateral mass fixation and fusion at the C5-6 level.

OUTCOME AND FOLLOW-UP

There were no neurological or other major surgical complications. When the patient was discharged from the hospital, he had regained some motor function in his upper extremities: grade 3/5 muscle strength in the right upper extremity and grade 2/5 muscle strength in the left upper extremity. He continued to have grade 0/5 muscle strength in his lower extremities and dysesthesia below bilateral C5 dermatomes.

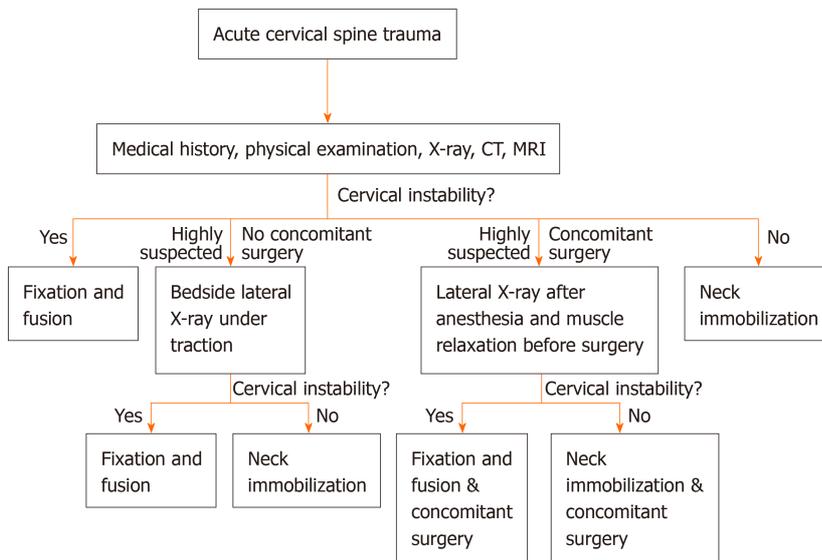


Figure 2 Clinical algorithm for diagnosing occult cervical spine instability. CT: Computed tomography; MRI: Magnetic resonance imaging.

Looking back at the preoperative images, we found that the MRI at the time of admission showed non-obvious high signal intensity at the C5-6 intervertebral disc and posterior interspinous ligament on T2 MRI (Figure 1B). This, in conjunction with a preoperative lateral X-ray, either under traction at the bedside or in the operating room after anesthesia and muscle relaxation prior to surgery, could have identified the occult cervical spine instability earlier rather than intraoperatively.

DISCUSSION

Medical history, physical examination, and multiple radiological techniques are used to diagnose instability of the cervical spine after acute traumatic injury. For patients with cervical spine tenderness and/or neurological deficit, static lateral X-ray is the first-line imaging modality for assessing obvious fractures or dislocation of the cervical spine. CT is the gold standard for detecting occult cervical spine fractures but is unable to detect instability in the cervical spine caused by injury to the intervertebral disc, ligament, or other soft tissue[6,7]. MRI provides detailed soft-tissue imaging but has a sensitivity of only 75% in detecting ligamentous injury[7,8]. Therefore, a more accurate and efficient protocol needs to be developed in order to prevent missed diagnoses of occult cervical spine instability.

Preoperative lateral X-ray under traction or after anesthesia and muscle relaxation should be used to evaluate occult instability of the cervical spine. Unlike in a standard lateral X-ray, lateral X-ray under axial traction provides the benefit of elongating the soft tissue of the neck, thus reducing muscle spasms that may obscure cervical spine instability on a standard lateral X-ray[9]. For patients who require concomitant trauma surgery, lateral X-ray can be obtained after anesthesia and muscle relaxation prior to surgery to assess the stability of the cervical spine. Some physicians may recommend getting flexion/extension lateral X-rays, which unlike static lateral X-rays, may detect instability of the cervical spine from a subtle disc or ligamentous injury[10,11]. However, the use of flexion/extension X-rays after acute cervical spine trauma is debated since this movement of the neck may aggravate the injury[12]. Generally, however, it is not advisable to use flexion/extension X-rays for patients with neurological deficits after acute trauma or for patients who have limited ability to flex or extend the cervical spine due to pain or muscle spasm. Therefore, we recommend a lateral X-ray under traction or after anesthesia and muscle relaxation as a safe and effective method for identifying occult cervical spine instability.

To help prevent missed diagnoses, we created a clinical algorithm to assist physicians with diagnosis of occult cervical spine instability (Figure 2). Upon patient presentation, medical history should be obtained, careful physical examination should be performed, and static lateral cervical spine X-ray, CT, and MRI should be performed to assess cervical spine instability. If lateral X-ray and CT do not show signs of cervical spine instability, but MRI suggests possible instability caused by soft-tissue

injury, bedside lateral X-ray under traction needs to be performed to determine whether there is indeed instability. If the patient requires concomitant trauma surgery, lateral X-ray after anesthesia and muscle relaxation should be obtained prior to surgical incision to evaluate stability of the cervical spine. To avoid missed diagnosis, careful review of preoperative MRI and lateral X-ray under traction or after anesthesia and muscle relaxation is necessary.

CONCLUSION

MRI of cervical spine trauma should be carefully reviewed to detect disco-ligamentous injury, which leads to further cervical spine instability. In patients with highly suspected cervical spine instability indicated on MRI, lateral X-ray needs to be performed under traction or after anesthesia and muscle relaxation to avoid missed diagnosis of occult cervical instability.

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