

Hemidiaphragmatic Paralysis Due to Cervical Spondylosis: A Case Report

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Abstract:

Introduction: C4 radiculopathy due to cervical spondylosis has rarely been reported as a cause of hemidiaphragmatic paralysis.

Case Report: A 70-year-old man presented with hemidiaphragmatic paralysis due to right C3-C4 foraminal stenosis. The diagnosis was made preoperatively from findings on plain chest radiographs, respiratory function tests, and electrophysiologic tests. All the patient's test results and symptoms improved immediately after surgical treatment for cervical spondylosis.

Conclusions: Although it may be difficult to make a correct diagnosis based only on radiological findings at the cervical spine, we should be aware of the existence of this entity and pay close attention to chest radiographs.

Keywords:

diaphragmatic paralysis, cervical spondylosis, radiculopathy

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Introduction

Diaphragmatic paralysis has been reported to occur subsequent to neoplastic lesions, traumatic injury to the phrenic nerve, cardiac surgery, or cervical spine surgery, such as anterior corpectomy and fusion¹⁻³. However, there are few reports in which the cause was cervical spondylotic radiculopathy.

In this report, we describe a patient with cervical spondylosis who developed unilateral diaphragmatic nerve palsy as a result of C4 radiculopathy and had a successful treatment outcome.

Case Report

A 70-year-old man complaining of a one-year history of persistent left arm pain and numbness of the hands bilaterally was referred to our hospital.

Manual muscle testing (MMT) revealed grade 4/5 strength in the deltoids bilaterally and in the right biceps. There was hyporeflexia in both biceps and hyperreflexia of both the triceps and the left patellar tendon. He also had radicular pain in the right C5 dermatome and hypoesthesia below the C5

dermatome.

Plain radiographs showed spondylotic changes and degenerative retropseudolisthesis at C3 (Fig. 1A, 1B). Magnetic resonance imaging (MRI) and a computed tomography (CT) myelogram (Fig. 1C, 1D) revealed spinal canal stenosis at the C3-C4 level and foraminal stenosis due to bony spurs and disc bulging at C3-C4 on the right and C4-C5 on the left. T2-weighted MRI showed a high signal change obscurely on the spinal cord. Based on these findings, the patient was diagnosed with cervical spondylotic myelopathy at the C3-C4 spinal level accompanied by left C5 radiculopathy.

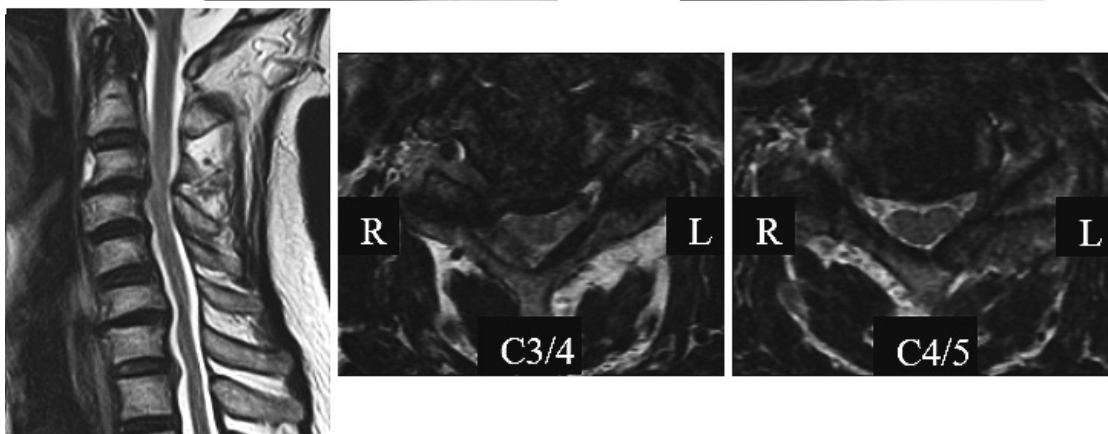
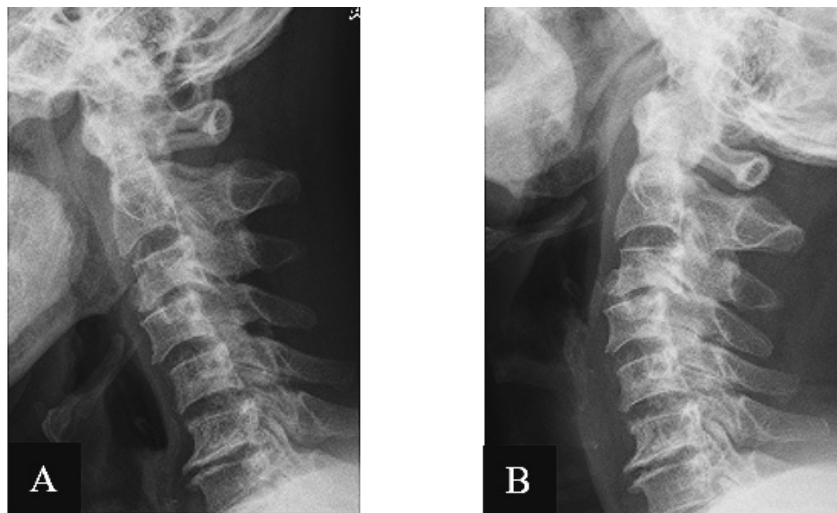
Plain chest radiographs taken as part of the preoperative evaluation revealed elevation of the right diaphragm after maximal inspiration, suggesting diaphragmatic paralysis (Fig. 2). Spirometry revealed a vital capacity (VC) of 2.75 L (percent VC: 90.2%), tidal volume of 0.63 L, inspiratory capacity of 2.05 L, and FEV_{1.0%} of 72.5%. Accordingly, the patient was referred to our Department of Respiratory Medicine for further examination, but no organic disease was identified.

Nerve conduction studies were performed. Transcutaneous phrenic nerve stimulation showed a decrease in amplitude of

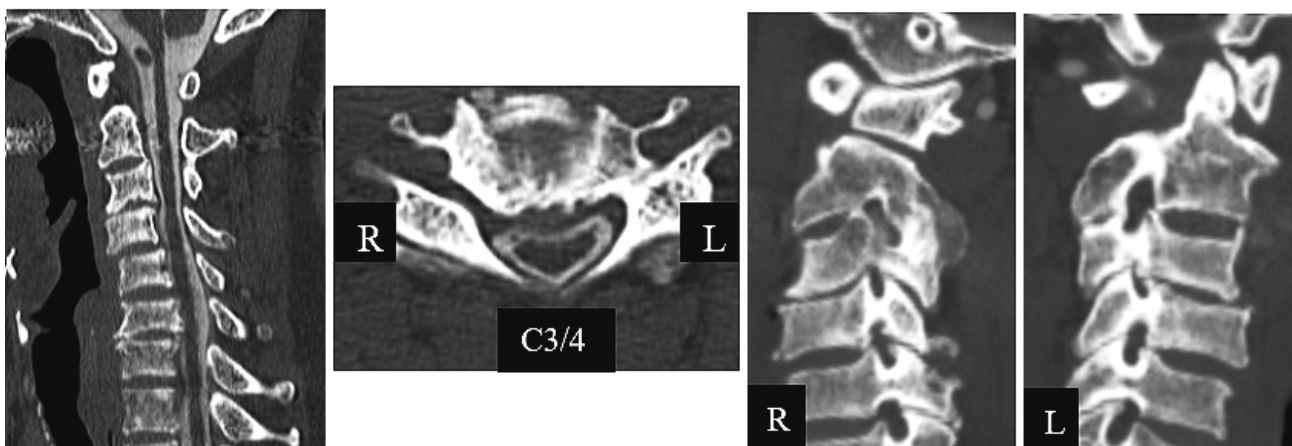
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(C) T2weighted preoperative magnetic resonance image



(D) Post-myelogram computed tomography scans

Figure 1. Dynamic plain radiographs (A: flexion; B: extension) showing degenerative retrospodylolisthesis at C3. Preoperative magnetic resonance image showing compression of the spinal cord at C3-C4 and foraminal stenosis at C3-C4 on the right and at C4-C5 on the left (C). Postmyelogram CT scans showing the bony structure of the intervertebral foramina at C3-C4 on the right and at C4-C5 on the left (D).

more than 50% on the right when compared with the left (Fig. 3A). Electromyography of the paravertebral muscles showed late recruitment and polyphasic motor unit potentials at C4, confirming a neurogenic change at the right C4 nerve

root (Fig. 3B).

A double-door laminoplasty was then performed at C4, and a foraminotomy was performed at C3-C4 on the right and at C4-C5 on the left. Crossing C2 laminar screws and

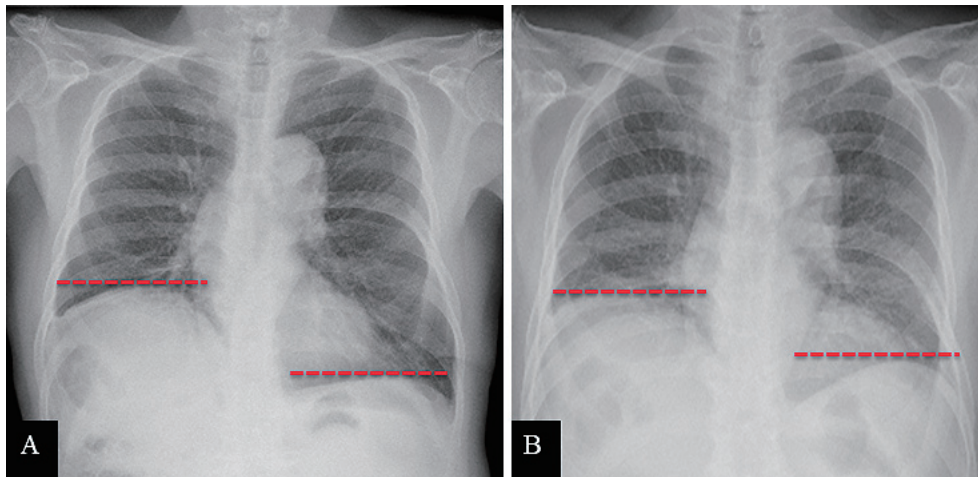
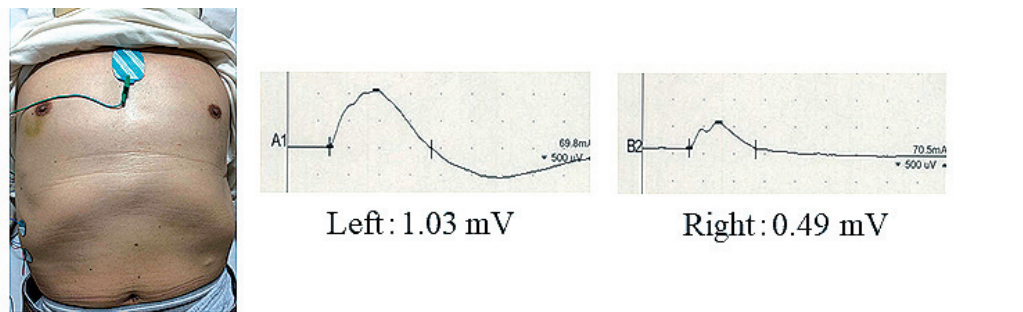
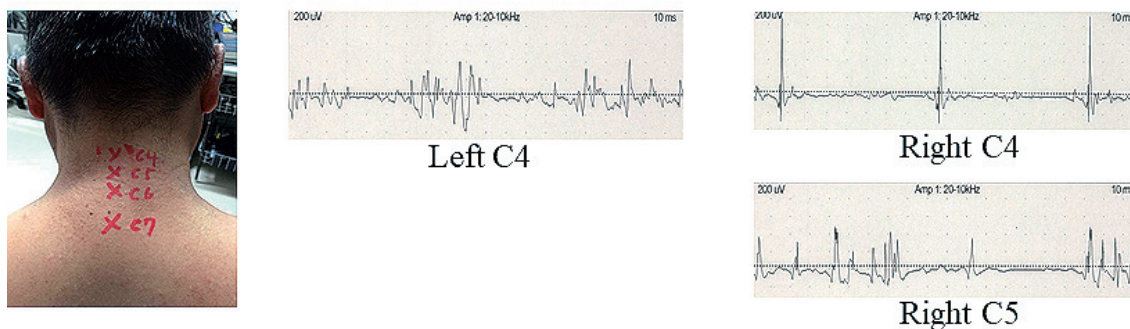


Figure 2. Preoperative chest radiographs (A: maximum inspiration; B: maximum expiration) showing poor movement of the right diaphragm.



(A) Transcutaneous phrenic nerve stimulation test



(B) Electromyography in paravertebral muscles

Figure 3. (A) Transcutaneous phrenic nerve stimulation test showing that the amplitude on the right side has decreased by more than 50% when compared with the left side. (B) Electromyography of the paravertebral muscles showing late recruitment and polyphasic motor unit action potentials at C4.

lateral mass screws were inserted at C3-C5 using the Roy-Camille or Magerl technique, and the deformity was corrected using a connecting rod. We performed on-lay bone grafting at the C2-C5 lamina using autologous local bone.

Postoperatively, MMT of the deltoid on both sides and the biceps on the right showed full recovery. Plain radiographs showed improvement of alignment (Fig. 4A, 4B), and enlargement of the spinal canal was revealed by CT scans. Two weeks postoperatively, a chest radiograph re-

vealed movement of the right diaphragm with respiration and good expansion of both lungs (Fig. 4C, 4D). Postoperative respiratory function tests performed ten days postoperatively showed a VC of 3.13 L (percent VC: 102.6%), tidal volume of 0.84 L, inspiratory capacity of 1.97 L, and FEV_{1.0%} of 72.3%. Two years after the surgery, the patient was making steady progress and radiological findings showed bony union.

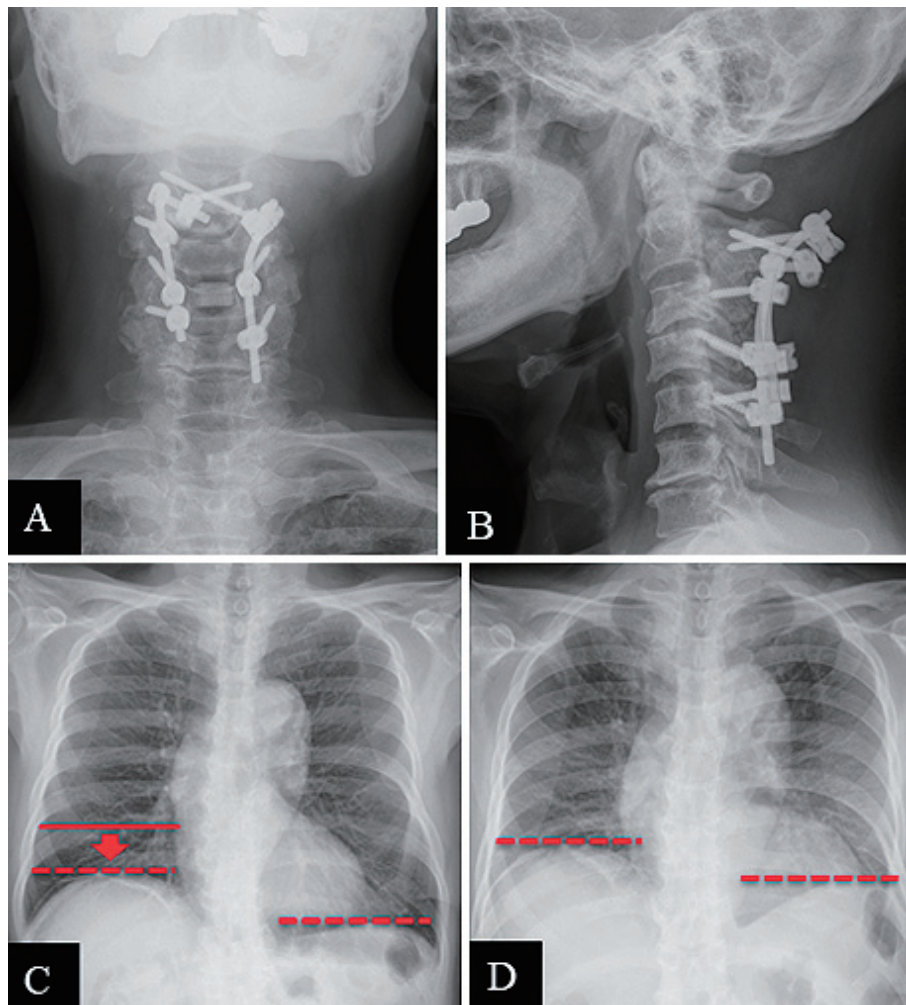


Figure 4. Postoperative radiographs (A, B) showing improvement of alignment and appropriate setting of the implant. Postoperative radiographs (C: maximum inspiration; D: maximum expiration) showing descent and mobility of the right diaphragm.

Discussion

Hemidiaphragmatic paralysis usually has minor subjective symptoms and thus is identified incidentally. Therefore, little attention has been paid to this finding⁴⁾. It is well known that respiratory dysfunction associated with chronic-onset myelopathy should be regarded as a neurological disorder⁵⁾. However, in patients with C3/C4 foraminal stenosis, we have to recognize the possibility of phrenic nerve palsy arising from C4 entrapment radiculopathy.

Compression of the C4 nerve root has very occasionally been reported as a cause of diaphragmatic nerve palsy^{6,7)}. However, immediate recognition of C4 radiculopathy as the cause of hemidiaphragmatic paralysis is difficult based on radiologic findings alone. Electrophysiologic tests, including nerve conduction studies such as phrenic nerve stimulation and electromyography, are extremely useful for the diagnosis^{8,9)}.

In conclusion, we should be aware of the existence of this entity and pay close attention to chest radiographs. Particularly, in cases with C3-C4 foraminal stenosis, plain chest radiographs on maximum inspiration and expiration may be

useful for screening.

Conflicts of Interest: The authors declare that there are no relevant conflicts of interest.

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