CASE REPORT

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Neurophysiological confirmation of phrenic nerve affection in a patient with dyspnea and herpes zoster

Neurofiziološka potvrda zahvaćenosti freničnog nerva kod bolesnika sa dispnejom i herpesom zosterom

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Abstract

Introduction. Herpetic lesion of the phrenic nerve is quite uncommon. These lesions are usually unilateral, and for most clinicians, the clinical manifestation of herpes zoster in the cervical or thoracic region and diaphragmatic paralysis on the same side is sufficient for making a diagnosis of segmental herpes zoster phrenic nerve palsy. We report a patient with a classic clinical picture, in which we confirmed phrenic nerve affection on nerve conduction study. **Case report.** A 58-year-old female patient came for an examination due to shortness of breath. The patient had a herpetic rash on her right shoulder two and a half months earlier. The elevation of the right hemidiaphragm was seen on chest X-ray imaging. Asymmetry was evident in the nerve conduction study of the phrenic nerve: prolonged latency and reduced amplitude of her right phrenic nerve. The patient was treated with acyclovir, pregabalin, and B complex vitamins. After six months, the motor deficit was reduced completely. **Conclusion.** A nerve conduction study of the phrenic nerve is useful in making the definitive diagnosis. Good outcome, as in this patient, is rare in patients with this diagnosis and may be linked to timely treatment with acyclovir.

Key words:
diagnosis; electrodiagnosis; herpes zoster; nerve conduction studies; phrenic nerve.

Apstrakt

Uvod. Herpetična lezija freničnog nerva je veoma retka. Te lezije su obično jednostrane i za većinu kliničara je klinička manifestacija herpes zostera u cervikalnom ili torakalnom regionu, uz paralizu dijafragme na istoj strani, dovoljna za postavljanje dijagnoze segmentne paralize freničnog nerva. Prikazujemo bolesnicu sa tipičnom kliničkom slikom kod koje je zahvaćenost freničnog nerva potvrđena ispitivanjem provodljivosti nerva. **Prikaz bolesnika.** Bolesnica stara 58 godina javila se na pregled zbog tegoba sa disanjem u vidu „kratkog" daha. Bolesnica je dva i po meseca ranije imala herpetični osip na koži desnog ramena. Rendgenskim snimkom grudnog koša utvrđena je podignuta desna hemidijafragma. Ispitivanjem provodljivosti freničnog nerva utvrđena je jasna asimetrija: produžena latencija i redukovana amplituda desnog freničnog nerva. Bolesnica je lečena aciklovirom, pregabalinom i vitaminima B kompleksa. Šest meseci kasnije, motorički deficit se potpuno povukao. **Zaključak.** Ispitivanje provodljivosti freničnog nerva je korisno za postavljanje definitivne dijagnoze. Povoljan ishod, kao kod prikazane bolesnice, redak je kod bolesnika sa tom dijagnozom i može biti povezan sa blagovremenim lečenjem aciklovirom.

Ključne reči:
dijagnoza; elektrodijagnostika; herpes zoster; živci, provodljivost, ispitivanje; frenični nerv.

Introduction

The diaphragm is innervated by the phrenic nerve, which originates from the anterior horn of the spinal cord (mainly C4 and partially C3 and C5 roots). Therefore, the phrenic nerve plays a crucial role in breathing. It is believed that reactivated varicella-zoster virus (VZV), from initial infection during chickenpox in childhood, can lead to the development of diaphragmatic paralysis and shortness of breath. Herpetic lesions of the phrenic nerve and consecutive diaphragmatic paralysis are extremely uncommon, and there are no accurate data about their frequency [1]. Cervical herpes zoster (HZ) and diaphragmatic paralysis were first described in 1949 [2]. Herpetic lesions of the phrenic nerve are usually

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unilateral, and for most clinicians, the clinical manifestation of HZ in the cervical or thoracic region and diaphragmatic paralysis on the same side is sufficient for making a diagnosis of segmental HZ phrenic nerve palsy [3]. There are only a few publications on the neurophysiological confirmation of phrenic nerve damage in segmental HZ paresis [1].

Case report

We present a 58-year-old female patient with paresis of the right hemidiaphragm and neurophysiologically demonstrated affection of the phrenic nerve as the reason for this weakness. She consulted her doctor because of shortness of breath. The patient had no previous history of smoking, malignancy, trauma, or chest surgery. Two and a half months earlier, she had a herpetic rash on her right shoulder, accompanied by intense pain. She noted weakness in her right shoulder and arm after that, along with the withdrawal of herpetic rash. During the inspection of the patient, dyspnea reduced respiratory excursions; the use of intercostal and accessory inspiratory muscles during inspiration in the region of the right hemithorax was noted. There was a pale herpetic rash in the area of her right shoulder (Figure 1). Moderate weakness during abduction of her upper right arm [Muscle Power Assessment (MRC) 4/5] was present; the right triceps reflex was abolished, and dysesthesia in the right shoulder region was evidenced. On the chest X-ray imaging, the elevation of the right hemidiaphragm was seen (Figure 2). Furthermore, no other pathological findings and possible causes of the phrenic nerve compression were noted on this scan. To prove diaphragmatic paralysis originating from phrenic nerve involvement, we performed a nerve conduction study (NCS) of this nerve and needle electromyography (EMG) of the diaphragm. We noted prolonged latency (11 ms) and reduced amplitude (0.1 mV) of the right phrenic nerve. The left phrenic nerve latency was 6.63 ms, and the amplitude was 0.45 mV (Figure 3). EMG of the diaphragm on the left side recorded a rhythmic electrical activity of inspiration as bursts of an interference pattern, separated by regular intervals of electrical silence during passive expiration. No such activity was noticed on the affected right side. EMG of her right arm revealed the existence of a neurogenic pattern and fibrillation in the right deltoid muscle. On the left side, the results of electrodiagnostic tests were normal. We performed a magnetic resonance imaging of the cervical spine, which showed only mild degenerative lesions, with no compressive radicu-

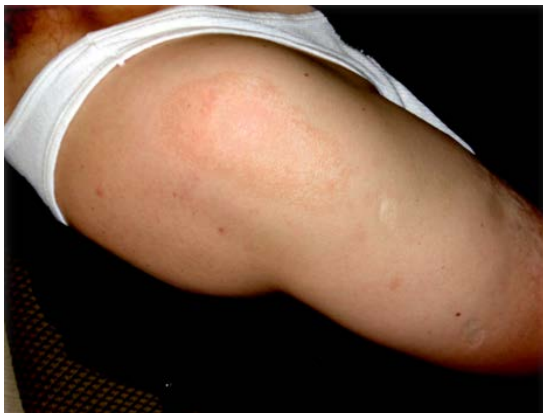

Fig. 1 – Herpetic rash on the patient's shoulder.

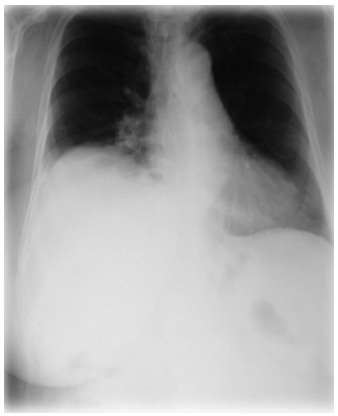

Fig. 2 – Chest X-ray imaging shows the elevation of the right hemidiaphragm.

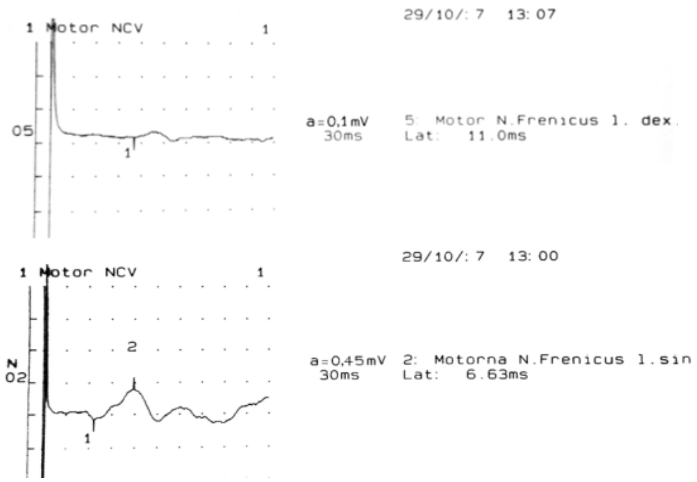

Fig. 3 – Phrenic nerve conduction studies. Note the right phrenic nerve M-response with reduced amplitude and prolonged latency. M – motor response, NCV– nerve conduction velocity.

lopathy or myelopathy. It was concluded that the patient has C5 radiculopathy due to the HZ infection (post-infectious radiculitis). The patient was treated with acyclovir (1,500 mg for 14 days), pregabalin (450 mg a day), and B complex vitamins. After six months, the motor deficit was completely reduced.

Discussion

The experience of an increase in the rate of HZ infection in patients older than 50 due to a decline in cell-mediated immunity with age is confirmed by the case of the presented patient (58 years old) [4]. Except for hypertension, the patient did not have any other diseases commonly seen in a population of patients with HZ, such as malignancy, diabetes mellitus, etc. According to the literature data, the maximal rash-to-weakness interval in patients with segmental limb paresis was 19 days [5]. A delay of 4–5 months is documented in patients with diaphragmatic paralysis [6]. That could be explained by the fact that the phrenic nerve is the longest motor nerve in the body, and, therefore, the time required for retrograde migration of VZV is longer. In the case of this specific patient, diaphragmatic weakness took two and a half months to appear after the HZ infection – much longer compared to the time of development of limb paresis. For most clinicians, the clinical manifestation of HZ in the cervical or thoracic region and ipsilateral diaphragmatic paralysis, when other known causes of phrenic nerve paralysis are excluded, is sufficient for making the diagnosis of segmental HZ paresis of the phrenic nerve [6]. Hemidiaphragm elevation was seen on chest radiography or computed tomography (CT) scans that had been used in the majority of previous papers for the confirmation of the diagnosis. The presence of hemidiaphragmatic paralysis may be suspected in patients who complain of dyspnea. It should be noted that half of the cases with diaphragmatic paralysis due to HZ had no symptoms referable to the respiratory system [7]. Furthermore, there are cases with normal chest CT which indicates insufficiency of this diagnostic measure [8]. Raised and immobile diaphragm is not by itself evidence of paralysis. It is necessary to demonstrate the paradoxical movement of the diaphragm after sudden inspiration on fluoroscopy or to prove phrenic nerve palsy (confirmed by the affection of the diaphragm motor action potential after phrenic nerve stimulation) [7, 9]. Only a few authors used neurophysiology to confirm the phrenic nerve paralysis [1, 7]. Electrodiagnostic confirmation of the phrenic nerve affection was used in the case of the presented patient. Because of prolonged reinnervation of the diaphragm due to the relatively long course of the phrenic nerve, the prognosis in patients with diaphragmatic paralysis is not good as it is segmental zoster paresis of limbs. In the case of phrenic nerve palsy, a lack of spontaneous recovery is not surprising. It is common for zoster-associated diaphragmatic paralysis to be permanent; still, recovery has occasionally been reported after seven and twelve months. That being said, in this case, the patient recovered completely within six months. Treatment of these patients with acyclovir has been reported only in a few patients [7, 8]. Only in one previous case report did the patient receive acyclovir intravenously [9]. Famciclovir was the therapy in one patient [10]. The presented patient was treated with acyclovir for two weeks with the complete withdrawal of the symptoms over the next six months. As postherpetic neuralgia is not rare in the cases of segmental zoster paresis, medicaments for neuropathic pain are recommended. In the presented patient, pregabalin was used for pain treatment.

Conclusion

We present a rare form of diaphragmatic HZ paralysis with electrophysiological confirmation of phrenic nerve involvement. Phrenic nerve conduction study is useful in making the definitive diagnosis. A favorable outcome, as in this case, is rare in patients with this diagnosis and may be linked to timely treatment with acyclovir.

Conflict of interest

The authors report no conflict of interest.

REFERENCES

1. *Bahadir C, Kalpakcioglu AB, Kurtulus D.* Unilateral diaphragmatic paralysis and segmental motor paresis following herpes zoster. Muscle Nerve 2009; 38(2): 1070–3.
2. *Halpern LS, Covner AH.* Motor manifestations of herpes zoster, report of a case of associated permanent paralysis of phrenic nerve. Arch Intern Med (Chic) 1949; 84(6): 907–16.
3. *Melcher WL, Dietrich RA, Whitlock WL.* Herpes zoster phrenic neuritis with respiratory failure. West J Med 1990; 152(2): 192–4.
4. *Yawn B, Gilden D.* The global epidemiology of herpes zoster. Neurology 2013; 81(10): 928–30.
5. *Reda H, Watson J, Jones L.* Zoster associated mononeuropathies: a retrospective series. Muscle Nerve 2012; 45: 734–9.
6. *Stowasser M, Cameron J, Oliver WA.* Diaphragmatic paralysis following cervical herpes zoster. Med J Aust 1990; 153(9): 555–6.
7. *Soler JJ, Perpiña M, Alfaro A.* Hemidiaphragmatic paralysis caused by cervical herpes zoster. Respiration 1996; 63(6): 403–6.
8. *Liu Y, Wu BY, Ma ZS, Xu JJ, Yang B, Li H,* et al. A retrospective case series of segmental zoster paresis of limbs: clinical, electrophysiological and imaging characteristics. BMC Neurol 2018; 18(1): 121.
9. *Berger R.* Case of Hiccups. J Emerg Med 2013; 44 (1): 107–8.
10. *Oike M, Naito T, Tsukada M, Kikuchi Y, Sakamoto N, Otsuki Y,* et al. A case of diaphragmatic paralysis complicated by herpes-zoster virus infection. Intern Med 2012; 51(10): 1259–63.

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