

# Cranial nerve Palsy following COVID-19 Vaccination Responsive to Plasma Exchange

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## Abstract

**Background:** Globally, mass COVID-19 vaccine administration has revealed various adverse effects of the vaccine, such as various neurological symptoms, which are currently identified as a result of an excessive immune response.

**Case report:** A 70-year-old woman presented with progressive unilateral oculomotor nerve palsy and decreased visual acuity 12 days after receiving the Moderna COVID-19 vaccine. In adults, such palsy is typically caused by microvascular disease (ischemia) or compressive tumors. Given the temporal relationship between vaccination and symptoms and the exclusion of other possible causative factors, the patient's oculomotor nerve palsy and optic nerve involvement was considered to be related to the vaccination. Cranial nerve palsy following COVID-19 vaccination was diagnosed, and after pulse steroid and plasma exchange, the patient showed steady recovery.

**Conclusion:** Our patient with cranial nerve palsy following COVID-19 vaccination responded well to plasma exchange after limited improved toward steroid. This case highlights the importance of early identification and treatment of the immunological effects of COVID-19 vaccines on cranial nerves.

## Keyword:

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## INTRODUCTION

As novel COVID-19 vaccinations are becoming prevalent, their adverse effects are receiving significant attention and warrant monitoring. In a phase 3 1:1 randomized trial of over 30,420 participants receiving Moderna mRNA COVID-19 vaccine or placebo, three in the vaccine arm and one in the placebo arm experienced Bell's palsy.<sup>[1]</sup> In a similar trial involving 38,000 participants receiving Pfizer-BioNTech mRNA vaccine

or placebo, four cases of Bell's palsy were reported in the vaccine arm. Moreover, in the COVID-19 Oxford/AstraZeneca vaccine trials, 3 of 12,021 participants in the vaccine arm and 3 of 11,724 participants in placebo arm developed facial nerve palsy.<sup>[2]</sup>

According to US Vaccine Adverse Event Reporting System, a national early warning system to detect possible safety problems in U.S.-licensed vaccines, the most commonly involved cranial nerves were oculomotor, trochlear, and abducens.<sup>[3]</sup>

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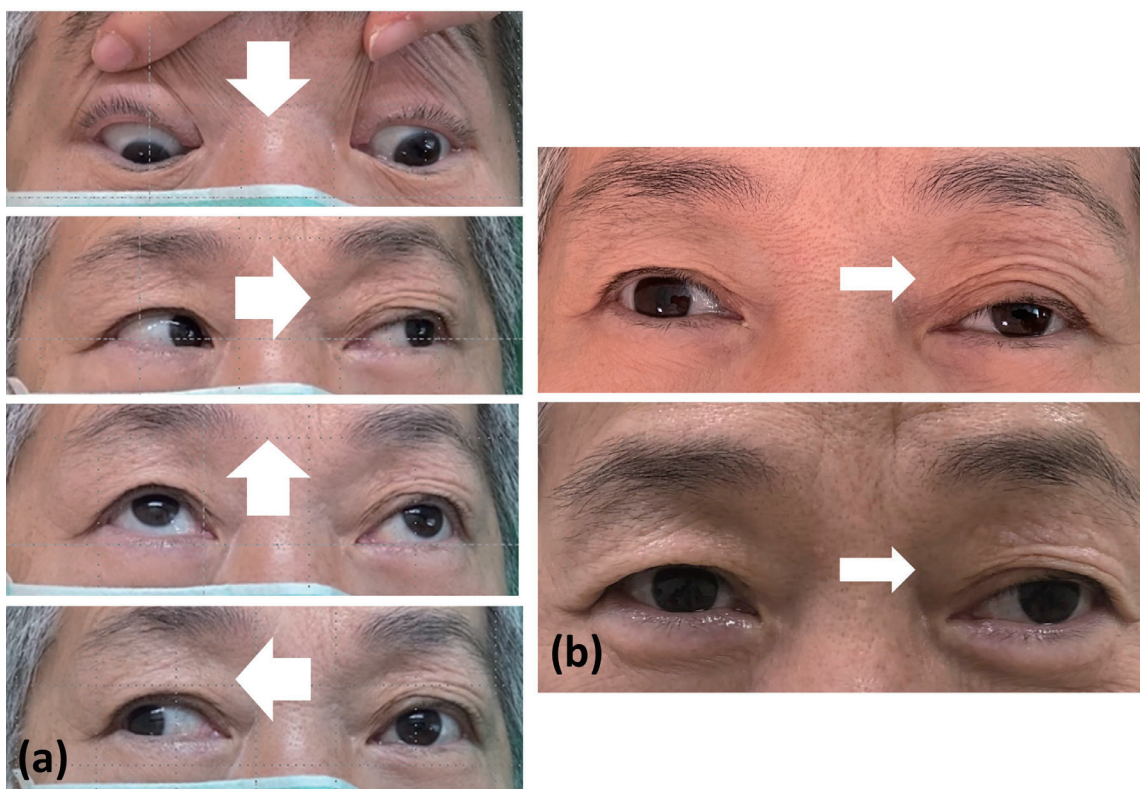
## CASE REPORT

A 70-year-old woman with a history of hypertension presented with a 2-day history of progressive diplopia, left ptosis, blurred vision and left retroorbital pain. She had received the first dose of Moderna COVID-19 vaccine 12 days prior. Neurologic examinations revealed left eye ptosis and oculomotor nerve palsy with binocular diplopia (Figure), with no other cranial nerves involvement. Motor strength according to the Medical Research Council grade was 5/5 in all limbs. Deep tendon reflexes were symmetrical and normal. No dysmetria or dysdiadochokinesia was observed on cerebellar function tests, such as the finger-nose-finger, heel-knee-shin, and rapid alternating movement tests. No sensory complaints or deficits were noted. The patient was immunocompetent and did not have signs of meningeal irritation. The patient's visual acuity, intraocular pressure, and results of slit-lamp and fundus examinations were normal. Laboratory examinations, including COVID-19 polymerase chain reaction, Anti-GQ1b IgG, IgM, and

systemic autoimmune diseases, revealed no abnormalities. Cerebrospinal fluid protein level was 33 mg/dL, with no pathogens identified.

Magnetic resonance imaging of the brain revealed normal and well-demarcated cranial nerves. Nerve conduction study of all limbs 5 days later indicated normal range of velocity and amplitude. Visually evoked potential (VEP) 12 days later revealed left prolonged P100 peak time (right, 110.7 ms and left, 168 ms).

The patient was diagnosed as having left optic and oculomotor nerve palsy following Moderna vaccine, given the temporal relationship. She received steroid pulse therapy: intravenous methylprednisolone 500 mg twice a day for 5 days, followed by 500 mg once a day for 3 days, 250 mg once a day for 2 days, and oral prednisolone tapering. After intravenous methylprednisolone, plasma exchange was performed five times for persisting symptoms, which led to an improvement of ptosis, visual acuity and retroorbital pain. The patient did not follow the VEP and ophthalmologic examinations after treatment and was discharged at the day 23 of admission.



**Figure.** (a) Left eye ptosis and third-nerve palsy was the initial presentation. (b) After pulse steroid therapy and plasma exchange, the ptosis in lower column showed improved comparing to upper column.

## DISCUSSION

Few cases have been reported of cranial neuropathies following with COVID-19 vaccination. There are some reports describing the development of cranial nerve palsy following Moderna and BNT vaccines.<sup>[4]</sup> However, the underlying pathophysiology remains unclear. It was postulated that nerves demyelination or localized nerve blood flow reduction was caused by immune-mediated damage. Most adverse effects of vaccines are triggered by aberrant immune responses and responses to pulse steroid therapy. Plasma exchange plays a vital role in the Guillain-Barré syndrome following SARS-CoV-2 vaccination and is also beneficial in COVID-19 vaccination-associated cranial neuropathies.

Initially, our patient presented isolated unilateral oculomotor nerve palsy. Risks for vascular and infection events were less evident because brain imaging and serum and CSF analysis indicated unremarkable findings. Idiopathic inflammation was indicated, and pulse steroid therapy was administered. Bilateral visual acuity was told normal at ophthalmologic examination on day 5, however VEP on day 12 showed left prolonged P100 peak time (right, 110.7 ms and left, 168 ms), hererin both left optic nerve and oculomotor nerve palsy involvement was impressed.

This humoral immune response of mRNA-based vaccines, such as Moderna, can trigger the autoimmune processes and produce antimyelin antibodies.<sup>[5]</sup> Our patient was diagnosed as having left optic and oculomotor nerve palsy following Moderna vaccine. After plasma exchange, the patient achieved a good therapeutic response. Compared with COVID-19 infection-associated cranial nerve neuropathy, the incidence of COVID-19 vaccination-associated cranial nerve neuropathy is very low.<sup>[6]</sup> Thus, the benefit of the vaccines far outweighs the risks, and the incidence of adverse effects is considerably low. Clinicians should continue to share these findings to allow further investigation of the causal relationship between vaccines and cranial neuropathies and exploration of the underlying immunologic pathophysiology.

We report a rare case of COVID-19 mRNA vaccine-associated left optic and oculomotor nerve palsy treated successfully with pulse steroid and plasma exchange. Early identification and management of potential neurological

complications of COVID-19 vaccines are paramount. The limitation of the case is the lack of objective VEP data after treatment and only comprising a single case, while the rarity of vaccines related cranial nerve palsy the efficacy of plasma exchange in steroid refractory cases had been illustrated.

There is no totally effective vaccine without risks. Currently, the benefits of the approved COVID-19 vaccines in preventing COVID-19 are considered to outweigh their side effects.<sup>[7]</sup>

**Patient consent:** Written informed consent was obtained from the patient for publication of this case report and accompanying images.

**Statement of ethics:** Written informed consent was obtained from the patient for publication of this report and accompanying images.

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**Conflict of interest:** The authors have no conflicts of interest associated with this manuscript.

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