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**Case Report**

# Optic Neuritis following Second Administration of COVID-19 Vaccine: A Case Report

Edward Saxton  Binita Panchasara  Susan Sarangapani

Luton and Dunstable Hospital NHS Foundation Trust, Luton, UK

**Keywords**
COVID-19 · Multiple sclerosis · Neuro-ophthalmology · Vaccination

**Abstract**
A 28-year-old woman presented to eye casualty with signs and symptoms suggestive of optic neuritis following a recent COVID-19 vaccination (the Moderna mRNA-1273 vaccine). The best corrected visual acuity was 6/15 in the right eye and 6/6 in the left eye with a relative afferent pupillary defect in the right eye. Following examination and investigation, she was found to fit the McDonald criteria for multiple sclerosis and was commenced on disease-modifying therapy. Demyelinating events have been identified to occur following COVID-19 vaccinations. In this case, we have found that the Moderna mRNA-1273 vaccine could have contributed to the development of optic neuritis following a second dose of the vaccine.



## Introduction

Since the year 2020, the whole world has been affected by COVID-19, suspending normal life activities with governments enforcing lockdowns in order to prevent overwhelming healthcare systems. COVID-19 vaccines became available to the public at the end of 2020, just 9 months after the pandemic was declared [1, 2]. It typically takes 10 years to approve vaccines before their distribution among the general public [3].

The relative novelty and pressurized approval of these vaccines has somewhat precluded our knowledge of their immediate and long-term effects, although the mRNA vaccines have thus far demonstrated a reasonable safety profile with the Moderna COVID-19 (mRNA-1273) vaccine being effective in around 94% of recipients [4, 5]. The mRNA vaccines work by

Correspondence to:
Edward Saxton, edwardsaxton96@gmail.com

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mimicking the spike proteins of the coronavirus, the part of the virus which is involved in attaching to the body's own healthy cells and infecting them. The theory is that by identifying these spikes more readily, the immune system is able to initiate a more effective response to the virus. Symptoms most likely to occur following a COVID-19 vaccination include soreness at the injection site, fatigue, headache, and nausea [6].

Since the COVID-19 vaccination programme has commenced, there have been reported cases of central nervous system demyelination [7]. Indeed, these have not been shown to have any clear causal relationship; however, highlighting these events is of importance in allowing us to understand the potential sequelae of this relatively new class of vaccine. Here we report the case of a young woman who developed optic neuritis following the Moderna COVID-19 (mRNA-1273) vaccine with a subsequent diagnosis of multiple sclerosis. The patient was seen in our eye casualty at Luton and Dunstable University Hospital. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see https://doi.org/10.1159/000531526).

## Case Presentation

A 28-year-old woman presented to the eye casualty with a 1-week history of reduced visual acuity in the right eye associated with pain on adduction and a right-sided headache. In clinic, prior to the onset of her visual symptoms, she received the second dose of the Moderna COVID-19 (mRNA-1273) vaccine which itself induced a flu-like syndrome that resolved within a few days.

Apart from myopia, the patient denied any previous ocular history. She had spinal surgery at 15 years of age for L5/S1 disc protrusion and uses a hearing aid for neurosensorial hyperacusia for which no genetic cause was found. She denied having any other neurological symptoms other than an episode of vertigo that developed prior to the onset of her visual symptoms, in addition to long-standing paraesthesia in her right hand and wrist. With regards to her family history, her mother has reduced unilateral vision from an unknown cause. She works as a customer care administrator and drinks alcohol occasionally with no history of smoking.

On examination, a review in clinic revealed reduced visual acuity (6/15 in the right eye and 6/6 in the left eye) and colour perception (Ishihara: 0/17 in the right eye and 17/17 in the left eye). A relative afferent pupillary defect was present in the right eye.

Her optic disc appearance and OCT scans were normal. Ocular motility was noted to be full; however, she reported pain on movement of the right eye.

The patient had a multitude of investigations performed. A full panel of blood tests were taken including an immunologic screen. All results were normal or not detected other than a positive JC virus result and varicella-zoster IgG antibody positive Table 1.

An initial MRI head with contrast revealed multiple foci of T2 hyper-intensities of the left caudate nucleus, deep white matter of the right parietal lobe, deep white matter of the left parietal lobe, juxtacortical punctate focus in the left temporal lobe, and posterior periventricular white matter oedema bilaterally (more so in the left) with involvement of the left side of the splenium of the corpus callosum. These were highly suspicious for demyelination. Enhancement of the lesion abutting the head of the left caudate nucleus suggested development of plaques in time and space. A subsequent MRI head and spine with contrast was performed following her review with neurology which showed new supratentorial, infratentorial, and cord lesions. These findings provide sufficient evidence of damage to the central nervous system that is disseminated in time and space, thus meeting the McDonald diagnostic criteria for multiple sclerosis.

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**Table 1.** Laboratory results

| Test | Result |
|---|---|
| Full blood count, liver function, renal function, thyroid function | Normal |
| Vitamin B12, coagulation, HbA1C | Normal |
| Folate | Low |
| T-spot | Negative |
| Hepatitis B screen | Not detected |
| Hepatitis C antibody | Not detected |
| HIV 1 and 2 antigen | Not detected |
| Syphilis IgG antibody | Not detected |
| Varicella-zoster IgG antibody | Detected |
| Anti-nuclear antibody (ANA) | Negative |
| Erythrocyte sedimentation rate (ESR) | Negative |
| Ref laboratory Borrellia (Lyme) serology *B. burgdorferi* IgG/IgM C6 EIA | Negative |
| Aquaporin 4 NMO antibodies | Negative |
| Myelin oligodendrocyte glycoprotein (MOG) antibodies | Negative |
| Serum protein electrophoresis | Normal pattern |
| JC virus | Positive |

The overall impression was of a right-sided optic neuritis, and accordingly, the patient was started on a 7-day course of methylprednisolone 500 mg with omeprazole cover. She was then commenced on disease-modifying therapy for multiple sclerosis.

## Discussion

The classic presentation of optic neuritis is described as decreased visual acuity in one eye associated with pain upon movement or orbital discomfort. On examination, the patient will typically have a relative afferent pupillary defect on the affected side alongside red desaturation and a reduction in visual field with occasional optic disc swelling [8]. Typically, a referral is made to neurology following a diagnosis of optic neuritis in order for the patient to be appropriately diagnosed and managed. Only a neurologist can make a diagnosis of multiple sclerosis using the McDonald criteria [9, 10].

There are many causes for optic neuritis with multiple sclerosis being one of the most common. Other causes include autoimmune conditions such as neuromyelitis optica and myelin oligodendrocyte antibody disorder which can affect the spinal cord as well as the optic nerves. Infections such as Lyme disease and measles in addition to drugs such as ethambutol are also known to affect the optic nerves [11]. Moreover, there have been reports of optic neuritis following COVID-19 infection [12, 13].

The pathogenesis of multiple sclerosis secondary to the COVID-19 vaccine is unknown. There are several proposed mechanisms, the most common of which is molecular mimicry, whereby the mRNA vaccine is recognised as a foreign antigen which results in autoimmune destruction of the nervous system. The reaction is thought to occur between the COVID-19 vaccine spike protein and tissue proteins such as myelin basic protein and the angiotensin-converting enzyme 2 (ACE2) receptor which can lead to demyelination [14, 15]. Another theory is that the vaccine might act as an environmental factor that increases the activation of

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antigen-presenting cells from an ongoing autoimmune process, similar to molecular mimicry [16]. The vaccine may also overstimulate B cell production and activation, leading to a heightened autoimmune response [17].

The JC virus was detected as part of the workup for multiple sclerosis. It is understood that the JC virus is present in a great majority of the population; however, it is in a dormant state [18]. The risk is that immunosuppressants to control multiple sclerosis progression can lead to developing progressive multifocal leucoencephalopathy causes rapid demyelination with no cure [19]. This makes treating the multiple sclerosis quite difficult to not activate the JC virus causing progressive multifocal leucoencephalopathy.

The COVID-19 vaccines are under constant evaluation due to the nature in which they were delivered so quickly to the public. The Moderna COVID-19 (mRNA-1273) vaccine is considered a safe vaccine to administer to the public in the UK as it provides very high levels of protection against symptomatic infection. According to the yellow safety reporting card on the UK government website, 5 cases of optic neuritis have been identified so far. Given the fact that several million of the Moderna COVID-19 (mRNA-1273) vaccines have been administered, the overall risk of this event is very low [20]. A study by Singh et al. [21] evaluated the side effects observed by recipients of the vaccine. The most common symptoms reported were headache, pyrexia, and fatigue. Rarer occurrences included Bell's palsy, Guillain-Barré syndrome, and transverse myelitis. The latter has been reported to occur following other vaccines such as for hepatitis B, influenza, diphtheria, and tetanus [22, 23].

Notably, as more COVID-19 vaccines are delivered to the population, optic neuritis is being identified as a potential side effect. An interesting distinction in this case is that the patient obtained the optic neuritis symptoms following the second dose of the Moderna COVID-19 (mRNA-1273) vaccine as compared to other reports of optic neuritis following the first dose of the COVID-19 vaccination. The first vaccine administration could act as a sensitising event before obtaining the full onset of optic neuritis symptoms following a second administration of the Moderna COVID-19 (mRNA-1273) vaccine.

This case highlights another potential consequence of the COVID-19 vaccine that can have considerable implications with regards to quality of life. Our case report is relevant to the fight against the COVID-19 pandemic as it highlights a potential adverse effect of the vaccine. It highlights an incident which can help contribute to the long-term safety information about this new vaccine. This case report also highlights the impact of potential consequences of the COVID-19 vaccine, and it can aid ophthalmologists with their history-taking and their understanding of potential causes of such presentations. In patients that have previously suffered demyelinating episodes, being aware of the potential for the vaccine to trigger further episodes will help us manage the conversation around administration of the vaccine, particularly during the initial management period of demyelinating disease. In spite of this, the overall safety profile and benefits conferred by the vaccines make them a key part of our battle against the virus. Indeed, further studies are necessary to further our understanding of the consequences of the vaccines to ensure their continued safe use.

## Statement of Ethics

Ethical approval is not required for this study in accordance with local or national guidelines. Written informed consent was obtained from the patient for publication of the details of their medical case.

## Conflict of Interest Statement

The authors have no conflicts of interest to declare.

## Funding Sources

No funding was received for this study.

## Author Contributions

Edward Saxton wrote the manuscript. Binita Panchasara critically revised the manuscript. Susan Sarangapani oversaw the case report write-up.

## Data Availability Statement

All data analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

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