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Bilateral optic neuritis and myocarditis after the first dose of COVID-19 vaccine

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A B S T R A C T

Since the introduction of COVID-19 vaccine, various adverse events have been reported including injection site pain, fatigue, headaches, and myocarditis. Cranial neuropathies and optic neuritis, have been rarely reported, however, the significance of these autoimmune manifestations after the administration of COVID-19 vaccine remain controversial. In this report we present a case of myocarditis and bilateral optic neuritis that occurred in a young healthy male patient after the administration of first dose of mRNA-1273 vaccine (Moderna).

Introduction

Since the discovery of the new SARS-CoV-2 (COVID-19) virus in the city of Wuhan in China, more than 160 million people have been infected, with more than 3 million reported deaths (WHO, 2020). Given the global threat, the expedited development and approval of COVID-19 vaccines became the only hope to end this pandemic and with the widespread distribution of COVID-19 vaccine worldwide, various adverse effects have been reported including injection site pain, fatigue, headaches, and myocarditis (Yadav et al., 2020; Centers for Disease Control and Prevention, 2021). The occurrence of various cranial neuropathies, and optic neuritis, have been rarely reported, however, the significance of these autoimmune manifestations after the administration of COVID-19 vaccine remain controversial. On the other hand, Centers for Disease Control and Prevention (CDC) issued a statement regarding a link between COVID-19 vaccination and myocarditis for both the BNT162b2 vaccine and the mRNA-1273 vaccine (Moderna) (Centers for Disease Control and Prevention, 2021). In this report we present a case of myocarditis and optic neuritis that occurred in a young healthy male patient after the administration of first dose of mRNA-1273 vaccine (Moderna). The occurrence of both these side effects after receiving the very first dose of the vaccine makes this case unique.

Case presentation

A 40-year-old Caucasian male with history of amblyopia of the right eye presented to the emergency department (ED) for evaluation of vision loss and chest pain after he received first dose of mRNA-1273 vaccine (Moderna). He reported night sweats, chest pain, chest tightness, palpitation, and difficulty breathing that lasted 5 h. Over the next few days, he experienced similar symptoms that occurred 4-5 times/day lasting from 5 to 30 min. At the same time, he had noticed worsening of vision in both eyes, more so in the left eye that prompted him to present to the emergency room(ED) for evaluation. On arrival to the ED, his vital signs were within normal limits. His general exam was unremarkable. Neurologic examination was normal except for bilateral vision loss. Detailed neuro-ophthalmic examination showed visual acuity (VA) of 20/50 in the right eye (OD) and 20/40 in the left eye (OS). There was left relative afferent pupillary deficit (RAPD) as well as a constricted visual field of the left eye on confrontation. Dilated fundus exam showed grade 1 disc swelling in OD and grade 4 disc swelling with splinter hemorrhages in OS (Fig. 1). Humphrey automated perimetry 24-2 (SITA fast) showed superior peripheral defect OD with a median deviation (MD) of -3.63 db and constricted visual field in OS done with size 5 stimulus. Ocular Coherence tomography showed an average retinal nerve fiber layer (RNFL) thickness of 118 microns OD and 237 microns OS (Fig. 2). Complete blood count (CBC) and Comprehensive metabolic panel (CMP) were unremarkable. Troponin level was elevated at 0.043 ng/ml (reference range 0.00-0.033 ng/ml) and EKG was unremarkable. COVID-19 virus by PCR was not detected on multiple occasions.

Post-COVID vaccine myocarditis was suspected given the symptoms and elevated troponins. Brain and orbit MRI with and without contrast were unremarkable. Brain MR venogram showed no venous sinus thrombosis. Fluoroscopy guided lumbar puncture (LP) showed an opening pressure of 21 and closing pressure of 8. Cerebrospinal fluid (CSF) analysis showed slight elevation of protein (49ng/dl), 2 nucleated cells, and 2 red blood cells. CSF was negative for infections. Angiotensin converting enzyme (ACE), and RPR were all negative. There were no oligoclonal bands in the CSF. Serum Aquaporin-4 antibodies and Myelin oligodendrocyte antibodies were negative. Serum infectious and autoimmune markers were all negative. Based on the patient’s symptoms, detailed neuro-ophthalmic evaluation, and completed workup, he was diagnosed

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Fig. 1. Colored fundus photograph of both eyes showing grade 1 and grade 4 swelling of the optic discs of the right and left eye respectively. The left optic disc has splinter hemorrhages as well.

Fig. 2. Ocular tomography of the optic nerves and RNFL shows substantial elevation of left neuro-retinal rim tissue compared with the right eye. The extracted tomograph highlights the large elevation asymmetry between the eyes.
with bilateral papillitis. Given the onset of symptoms shortly after receiving first dose of mRNA-1273 vaccine (Moderna) and the exclusion of all other potential causes, the most probable etiology in this patient is COVID vaccine-related optic neuritis. The patient was treated with intravenous methyl prednisolone (one gram/day) for 2 days followed by 12 days of oral prednisone in tapering doses.

At 8 weeks follow-up, patient noted some improvement of his left eye vision. Ocular exam showed VA is 20/50 OD (believed to be due to amblyopia) and 20/25 OS with left RAPD. Color vision using Ishihara plates were 14/14 OU, Pelli Robson contrast sensitivity was reduced in OS. Fundus exam showed 1+ disc elevation OD and resolved disc edema with pallor OS. Humphrey automated perimetry 24-2 (SITA FAST) showed normal findings in OD and a constricted visual field in OS with a MD of -23.01 dB. Retinal nerve fiber analysis demonstrated improved average thickness in OD and significantly decreased thickness in OS with global atrophy (Fig. 3).

Discussion

The neuro-ophthalmic manifestations of COVID-19 viral infection are well established and extensively reported in the medical literature (Tisdale and Chwalisz, 2020). Optic neuritis has been reported to occur at various stages of COVID-19 viral infection. Cranial nerve palsies including oculomotor nerve and abducens nerve palsies have been reported (Tisdale and Chwalisz, 2020).

Vaccine-related optic neuritis is defined based on the existence of a temporal relationship between the application of a certain vaccine and the development of optic neuritis in the absence of other known infectious or non-infectious etiologies of optic neuritis (Karussis and Petro, 2014).

Vaccine related optic neuritis have been previously reported in relation to numerous vaccines, including MMR (measles, mumps, and rubella), hepatitis A, hepatitis B, diphtheria, pertussis, tetanus (DTP) and influenza vaccines. Other than case reports, there is limited scientific evidence to support these occurrences, and multiple studies have shown no association (Karussis and Petro, 2014; Jun and Fraunfelder, 2017).

The incidence of vaccine related optic neuritis varies between studies. In a review of the Vaccine Adverse Event Reporting System (VAERS) between 1990–2017, 186 cases of optic neuritis were identified. The rate of new post-vaccination ON was 6.93 per year which is in the range expected in the US population. Of the 186 cases of optic neuritis, 47% were reported following Hepatitis B vaccination and 19.8% following a HPV4 vaccine (Patel et al., 2018). In Chinese studies, the reported incidence of vaccine-related ON is 0.003- 0.89 per 100,000 (Lim et al., 2009).

Literature search for optic neuritis related to COVID-19 immunization showed four reported cases. This included a 19-year-old woman with bilateral vision loss after single-dose of the Ad26.COV2.S vaccine (Johnson & Johnson) (Estrada, 2022), a 69-year-old woman with bilateral optic nerve head edema, 16 days after the second dose of the Pfizer-BioNTech vaccine (Elnahry et al., 2021), a 32-year-old woman

Fig. 3. 8 weeks follow-up ocular topography of the optic nerves and RNFL showing improvement of the thickness of the right eye and significantly decreased thickness of the left eye with global atrophy.
with left optic neuritis six days after her first dose of the AstraZeneca-Oxford vaccine (Elnahry et al., 2021) and finally a case of thyroiditis and bilateral optic neuritis following COVID vaccine with CoronaVac (Leber et al., 2021).

The patient depicted in this report developed mild myocarditis and optic neuritis within two weeks of his first dose of COVID-19 vaccine. Extensive workup showed no other etiology for optic neuritis or other causes of optic disc edema. Given the temporal relationship between the onset of symptoms and vaccine application, and the absence of other etiologies his optic neuritis seemed vaccine related.

Pathophysiology of vaccine-related autoimmune diseases including optic neuritis is unclear. In general, COVID-19 vaccine results in the formation of high levels of neutralizing antibodies that recognize and target the spike proteins of the SARS-CoV-2 virus. Neutralizing antibodies against the spike proteins and/or activated T-helper-1 cells can cross react with proteins and antigens in the body resulting in various autoimmune related reactions (Karussis and Petrou, 2014; Jun and Fraunfelder, 2017), one of which could be optic neuritis.

Regarding post COVID-19 vaccine myocarditis; the CDC has estimated an incidence of 0.48 cases per 100,000 overall and 1.2 cases per 100,000 among vaccine recipients between the ages of 18 and 29 years after any COVID-19 vaccination (Centers for Disease Control and Prevention, 2021). Most cases of myocarditis are mild and self-limited just like our case. He presented with chest pain and elevated troponins without evidence of cardiac ischemia. His myocarditis was felt to be mild and improved with rest and use of oral nonsteroidal anti-inflammatory medications.

Although it is uncertain whether the development of optic neuritis after COVID-19 vaccination was consequential or coincidental, we postulate that the close temporal relationship with COVID-19 vaccination in the absence of other etiologies suggests the possibility of an autoimmune inflammation of the optic nerve head triggered by the vaccine. To the best of the author’s knowledge, this case is the first in the literature to report the occurrence of myocarditis and optic neuritis in the same patient.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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