Multiple cerebral arterial dissections with a ruptured blister aneurysm after COVID-19 vaccination

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Although extensive clinical data have verified the safety and adverse effects of coronavirus disease 2019 (COVID-19) vaccines, unexpected neurovascular events have rarely been reported. This report presents an unusual case in which we inferred that spontaneous multiple cerebral arterial dissections with a ruptured blister aneurysm occurred after COVID-19 vaccination. A 34-year-old woman presented with a severe headache, confusion, and mild weakness in her left arm 18 days after having received the Pfizer-BioNTech COVID-19 vaccine. Digital subtraction angiography showed fusiform dilatation in the proximal part of the left vertebral artery and luminal irregularities and string signs in the distal V4 segment. Stroke after vaccination involving multiple cerebral arterial dissections and simultaneous rupture of a blister aneurysm is a very rare phenomenon. Although laboratory studies such as cytoplasmic anti-neutrophil cytoplasmic autoantibody, perinuclear anti-neutrophil cytoplasmic antibodies, anti-cardiolipin, rheumatoid factor and lupus anticoagulant were checked in order to screen the patient for vasculitis and fibromuscular dysplasia, none of them showed significant results. The Pfizer-BioNTech COVID-19 vaccine that the patient had received a few days ago was the only plausible trigger. In conclusion, COVID-19 vaccination might lead to multiple cerebrovascular changes in a short period of time.

Keywords: COVID-19; Arterial dissection; Aneurysm; Digital subtraction angiography

Introduction

Since coronavirus disease 2019 (COVID-19) was turned into a pandemic, numerous efforts which include taking preventive measures such as wearing facial masks, keeping social distance and strengthening quarantine, and a lot of testing for individuals etc. have not been sufficient to control it. So far, vaccination has been regarded as the best strategy to control the pandemic and several COVID-19 vaccines including the process of clinical trials have been developed and launched into the market.

Although a great number of clinical data have verified the safety and adverse effects of COVID-19 vaccine, unexpected neurovascular events have been rarely reported. Among them, stroke may be the biggest issue [1,2]. Here in, we are going to report the unusual case in which we infer that spontaneous multiple cerebral arterial dissections with a ruptured blister aneurysm have been occurred after a vaccination.

Case Report

This study was approved by the Institutional Review Board (IRB) of Kangdong Sacred Heart Hospital (IRB No: 2022-08-016) which waived the requirement for informed consent due to the respective nature of the study.

A 34-years-old woman presented with a severe headache, confusion and mild weakness in her left arm 18 days after having received the Pfizer-BioNTech COVID-19 vaccine. She had no pre-existing medical condition and did not take any other medications. Her family members did not have any history about the cerebral vascular disease and genetic disorder. She also did not have any recent history of trauma, strenuous exercise, fever and cough. While she was treated at the emergency room, nasopharyngeal swab was...
negative for RNA of the COVID-19.

A computed tomography scan on admission revealed acute subarachnoid hemorrhage (SAH) on the basal cistern, peri mesencephalic cistern, and both Sylvian cistern as Fisher III grade. After controlling of the blood pressure, she had immediately performed the digital subtraction angiography (DSA) to evaluate the causative origin of the SAH. DSA showed that the proximal part of left vertebral artery was seen the fusiform dilatation and distal V4 segment was noted as a luminal irregularities and string signs. The left distal internal carotid artery (ICA) and right proximal ICA were also seen as the focally dissected flap, and the luminal narrowing of the right proximal ICA was severely progressed. The bleeding focus was identified as a ruptured blister aneurysm on the dorsal side of distal ICA.

Under general anesthesia, 8 Fr Asahi Fubuki guiding catheter (Asahi Intecc, Aichi, Japan) was positioned in the right common carotid artery (CCA) and a Emboshield 7.2 mm (Abbott Vascular, Santa Clara, CA, USA) was placed at the distal ICA. Acculink 6-8/40 (Abbott Vascular) stent without ballooning was deployed from the CCA to the proximal ICA for covering the stenotic part of the proximal ICA (Fig. 1). After the full expansion to the lesion, 8Fr guiding catheter was changed to 6 Fr benchmark (Penumbra, Alameda, CA, USA) guiding catheter to manage the distal ruptured part. An Excelsior SL-10 S-shape microcatheter (Target Therapeutics, Fremont, CA, USA) was navigated into the aneurysm, and a partial frame was made by the first coil. A Prowler Plus microcatheter (Cordis Neurovascular, Miami Lakes, FL, USA) was carefully moved beyond the aneurysmal neck to deploy the stent. Double stents (2 enterprise stents 4/23, 4/16; Cordis Neurovascular) assisted coiling technique was applied to secure the ruptured blister aneurysm (Fig. 2).

She had been hospitalized for a month for general care and neurological recovery. During this periods, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) RNA using real-time reverse-transcriptase polymerase chain reaction was shown negative result and no cough, fever, or dyspnea had been found. In addition, there were no specific relations to genetic factors from a laboratory study. The patient was discharged without neurological deficits and was confirmed that the ruptured blister aneurysm was completely occluded and other lesions were not changed at the follow-up angiography.

**Discussion**

COVID-19 vaccines motivate the immune system to create antibodies against SARS-CoV-2. It includes messenger RNA, vector, protein subunit, and inactivated vaccines and induces adaptive immunity [3,4]. Several research reported several types of vaccine induced strokes which resulted in overproduction of pro-inflammatory cytokines including interleukins, chemokines, and interferons during pandemic period [4]. It was common in women, and older people mainly related to thrombotic cerebral infarction and hemorrhage [3]. On the other hand, young and middle aged people are more affected by cerebrovascular venous thrombosis or embolic infarction [5].

Although several previous studies reported about relevant of age and incidence of spontaneous carotid artery dissection, COVID-19 vaccine related arterial dissection is not enough evidence to investigate the incidence rate with increasing patients aging. In comparison with previous carotid artery dissection studies,

![Fig. 1](https://doi.org/10.51638/jksgn.2022.00129)

**Fig. 1.** (A) This 3-dimensional reconstruction image of digital subtraction angiography (DSA) shows that luminal narrowing of the right proximal internal carotid artery (ICA) had severely progressed. (B) Post-procedure DSA image. Stent without ballooning was deployed from the common carotid artery to the proximal ICA for covering the stenotic part of the proximal ICA.

![Fig. 2](https://doi.org/10.51638/jksgn.2022.00129)

**Fig. 2.** (A) The bleeding focus was identified as a ruptured blister aneurysm on the dorsal side of the distal internal carotid artery (ICA). A 4.82-mm aneurysm neck size was measured on a 3-dimensional reconstruction image. (B) Post-procedure digital subtraction angiography image. Coil embolization in a ruptured blister aneurysm on the dorsal side of the distal ICA. The double stent-assisted coiling technique was performed.
this case report is not a spontaneous event (strongly speculating that she had a stroke after vaccination), multiple cerebral artery dissection, a young woman without medical history. In general, multiple cerebral arterial dissections accompanied by the rupture of a blister aneurysm is a very rare phenomenon. Numerous risk factors could have been postulated about the event. In this regard, the patient showed a healthy daily life without underlying disease and genetic disorder. To confirm immunologic factors, laboratory studies such as cytoplasmic anti-neutrophil cytoplasmic autoantibody, perinuclear anti-neutrophil cytoplasmic antibodies, anti-cardiolipin, Rheumatoid factor and lupus anticoagulant for screening vasculitis and fibromuscular dysplasia were conducted. Nevertheless, results were not obvious. The Pfizer-BioNTech COVID-19 vaccine taken a few days ago was the only prerequisite.

Considering previously reported several arterial dissections after COVID-19 infection or vaccination, arterial dissection complication of COVID-19 is uncommon but COVID-19 is considered to trigger exaggerated inflammatory response fulminant [2,6,7]. Hemorrhagic strokes occur after COVID-19 vaccination, which can be primary or secondary to venous thrombosis [8,9]. Coagulopathy and vascular endothelial dysfunction resulted from an exaggerated systemic inflammation. The cytokine storm or direct SARS-CoV-2 invasion of the vascular endothelial cells makes endothelial dysfunction [4]. This phenomenon can potentially result in vascular dissection [10,11]. Several causative mechanisms have been discovered indicating COVID-19 might increase the risk of having a stroke. Vaccination probably makes human immune system exaggerated. Despite having not been proven yet, “Cytokine storm” is systemic inflammation which potentially occurred after vaccination [10,12].

Arterial dissection could be one of the unusual complications of COVID-19 vaccination or infection. From this case, it is considered that head and neck image work up including DSA should be performed in stroke patients after COVID-19 vaccination [1,9].

**Conclusion**

It is a rare case that COVID-19 vaccination might give an influence to the multiple cerebrovascular changes in a short period of time. Furthermore, it is needed to clearly evaluate the physiological impact on the cerebral vessels after the vaccination.

**Conflicts of interest**

No potential conflict of interest relevant to this article was reported.

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mune thrombotic thrombocytopenia (VITT): update on diag-