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COVID-19 AND AORTIC DISSECTION

Shojiro Takasu[1,*], Mitsuko Ariizumi[1,2], Sari Matsumoto[1], Yuko Kanto[1], Kimiharu Iwadate[1]

Jikei University, School of Medicine, [1]Department of Forensic Medicine, [2]Department of Radiology, Tokyo, Japan

Abstract: Coronavirus disease 2019 (COVID-19) is a disease that is caused by the SARS-CoV-2 virus. Despite the fact that COVID-19 may also have a relationship with aortic dissection, more research is required to confirm this coherence. A 47-year-old man with no medical history was found dead at his home. Before passing away, he showed coughing symptoms. Postmortem computed tomography revealed the aortic wall of the Valsalva sinus underneath the entrance of the left main trunk of the coronary artery had thickened. At the time of autopsy, laceration was seen in the Valsalva sinus's intimal layer, right beneath the entry of the left main trunk of the coronary artery, and the dissection was localized from the Valsalva sinus to the anterior descending coronary artery. Histologically, medial necrosis was observed in the arterial media only near the false lumen. The RT-qPCR test for SARS-CoV-2 was positive even though the fast antigen tested negative. Aortic dissection-induced myocardial infarction was determined to be the cause of death. Although undiagnosed hypertension could have contributed to aortic dissection, the association of SARS-CoV-2 was proposed due to the lack of medical history and the localization of the medial necrosis at the dissection site.

Keywords: COVID-19, SARS-CoV-2, aortic dissection, myocardial infarction, forensic pathology.

INTRODUCTION

The SARS-CoV-2 virus is the cause of the disease known as coronavirus disease 2019 (COVID-19). Patients with COVID-19 have an increased risk of developing cardiovascular disease, like acute myocardial injury, arrhythmias, cardiogenic shock, acute coronary syndrome, and venous thromboembolism [1-4]. Although it is suspected that aortic dissection is also suggested in COVID-19 patients, further studies are needed to establish this coherence [5-9].

To the best of our knowledge, no autopsy report has been made for aortic dissection in a COVID-19 case. Here, we provide an autopsy instance of an aortic dissection-related myocardial infarction that may be related to COVID-19.

CASE REPORT

The deceased was a 47-year-old nonsmoker man without a medical history. The SARS-CoV-2 virus vaccination status was unknown. He had coughing symptoms but did not undergo a medical examination. The next day, he went to his room after taking lunch. He was discovered dead on his bed in a prone position one hour later. Uncertainty over the cause of death prompted our facility to conduct a medicolegal autopsy. Noncontrast computed tomography (CT) was performed in the supine position using a 64-detector row CT (Somatom go. Top; Siemens Healthineers) prior to autopsy. At the Valsalva sinus, which is underneath the entry of the left main trunk of the coronary artery, the aortic wall thickening was seen (Fig. 1).

The cadaver was 171 cm in height and 83.7 kg in weight (body mass index = 28.6 kg/m^2) at the time of autopsy. A heart weighed 534 g and contained 420 mL of dark red blood with fluidity, according to an inside examination. No occlusion due to atherosclerosis was observed in any coronary artery. The intimal layer of the aortic wall showed mild to moderate atherosclerosis, and the intimal layer of the Valsalva sinus showed laceration right underneath the opening of the left main trunk of the coronary artery (Fig. 2). The false lumen extended from the Valsalva sinus close to the laceration to the anterior descending coronary artery, and the laceration was 3 cm in length.

*Correspondence to: Shojiro Takasu MD, PhD, Jikei University, School of Medicine, Department of Forensic Medicine, 3-25-8, Nishi-shinbashi, Minato-ku, Tokyo 105-8461, Japan, E-mail: s-takasu@jikei.ac.jp

Histologically, the arterial media near the false lumen showed medial necrosis and lymphocyte infiltration, while the myocyte of the left anterior wall showed contraction band necrosis (Fig. 3). No medial necrosis was observed in any other site of the aorta. Further, no myocardial disarray was observed. The left and right lungs weighed 528 and 604 g, respectively. There was pulmonary emphysema in both lungs, but no signs of pulmonary thromboembolism, pneumonia, and diffuse alveolar damage. The left and right kidney weighed 186 and 185 g, respectively. Histologically, mild glomerulosclerosis was observed. The remainder of the macroscopic and microscopic examination was unremarkable.

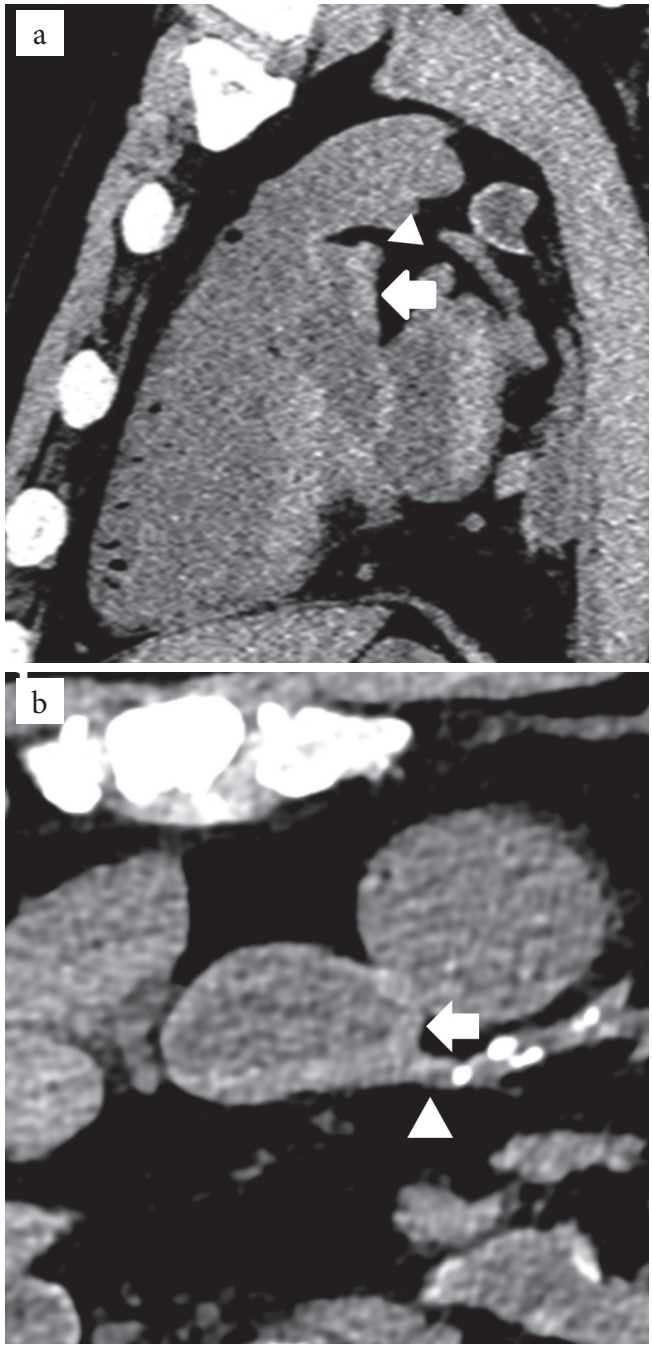

Figure 1. Postmortem computed tomography. The thickening of the aortic wall (arrow) was observed at the Valsalva sinus under the left main trunk of the coronary artery (arrowhead): a) Sagital and b) axial image.

Prior to the autopsy, a nasopharyngeal swab was collected through the nasal cavity for the rapid antigen test and reverse transcription-quantitative polymerase chain reaction (RT-qPCR) assay. The RT-qPCR test was positive for SARS-CoV-2, with a cycle threshold (Ct) value of 30.78 even though a nasopharyngeal swab tested negative for SARS-CoV-2 by the fast antigen test. The cardiac blood drawn during the autopsy had a serum C-reactive protein (CRP) level of 0.06 mg/dL. No alcohol or other drugs were detected in the cardiac blood.

DISCUSSION

Myocardial infarction caused by aortic dissection that developed to the anterior descending coronary artery was determined to be the cause of death in this case. Although the RT-qPCR tested positive for SARS-CoV-2, no signs of pneumonia and thrombosis were seen.

According to various reports, COVID-19 and aortic dissection are related [5-9]. However, the exact mechanism is still unknown. Angiotensin-converting enzyme2 (ACE-2) receptor which is expressed in the airway epithelia, kidney cells, small intestines, lung parenchyma, and vascular endothelia, is bound by spike proteins on the surface of SARS-CoV-2 [10]. As a result, this may harm the vascular endothelium [3, 10]. Patients with COVID-19 have a cytokine storm and inflammatory reactions that

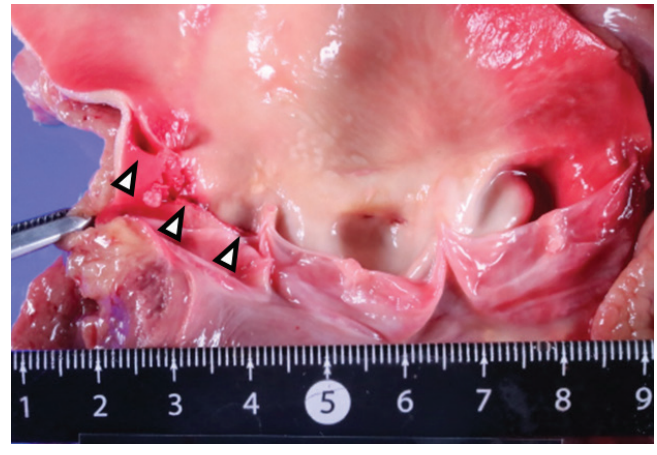

Figure 2. Lumen of the Valsalva sinus. A laceration 3 cm in length directly under the opening of the left main trunk of the coronary artery was observed (arrowhead).

result in endothelial dysfunction that could also cause rupture of the aortic intima [11]. An aortic dissection patient with COVID-19 was described by Akgul *et al.* [12] as having a considerable thickening of the aorta wall, which is typical of inflammatory aortic diseases. Vasculitis and aortitis are also reported in COVID-19 patients [8, 13, 14]. Additionally, studies have shown that COVID-19 infection could down-regulate ACE-2, which may promote the progression of atherosclerosis [3]. Aortic dissection may progress further if ACE-2 is down-regulated since this could stimulate the renin-angiotensin-aldosterone pathway and contribute to hypertension [3, 15].

Aortic pathology in SARS-Cov-2 positive cases affected 33% of patients, who had no concomitant conditions [8]. The deceased in this case had no history of connective tissue diseases, such as Marfan syndrome, Ehlers Danlos, and fibromuscular dysplasia. Because enlargement of the heart and glomerulosclerosis in the kidney was observed, the possibility of undiagnosed hypertension that could have contributed to the aortic dissection cannot be fully excluded. However, the atherosclerosis of the aorta was mild to moderate and medial necrosis was only observed at the site of the

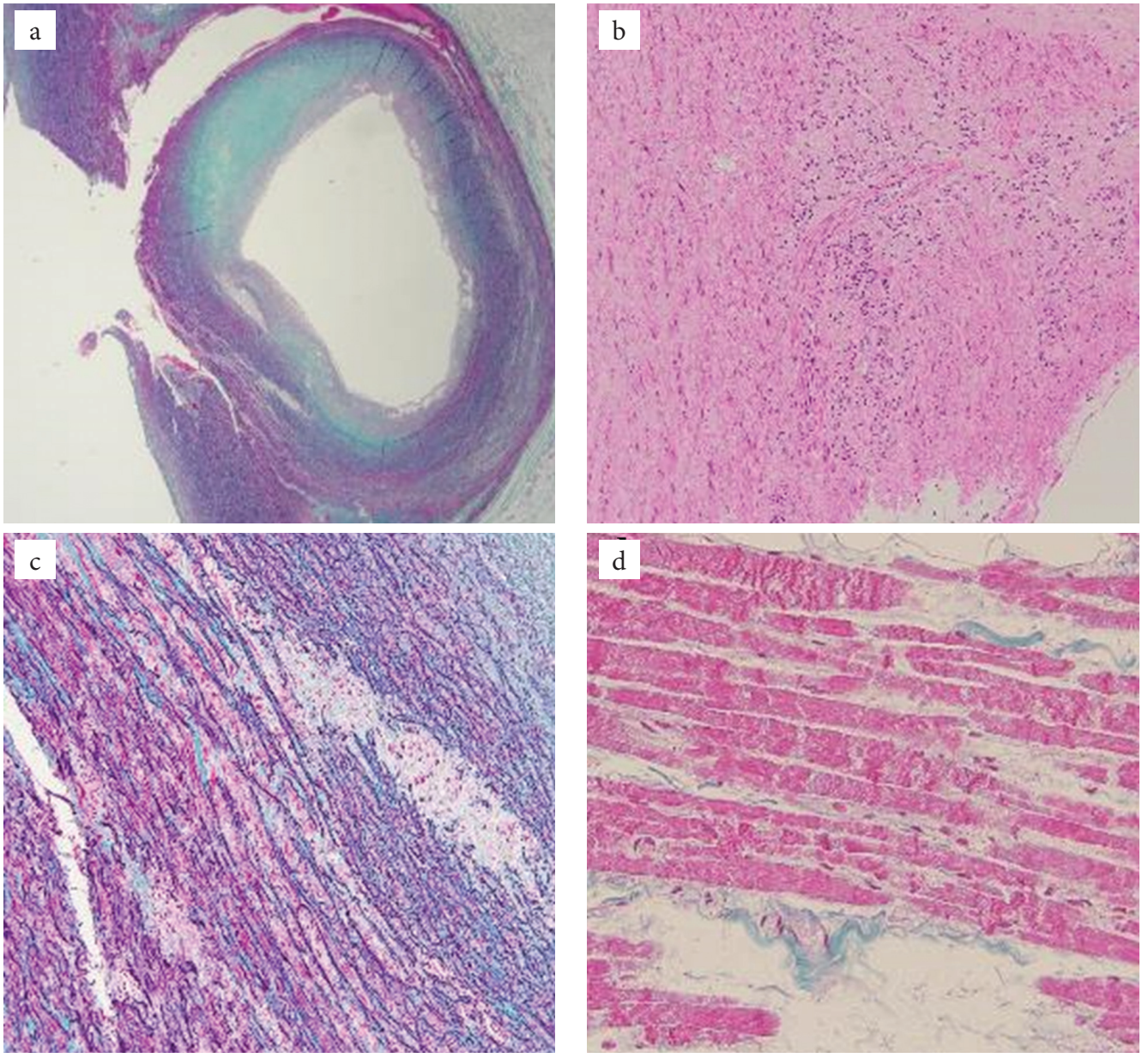

Figure 3. Histopathology of the dissection site and heart: a) laceration of the aortic wall (Elastica Masson-Goldner staining, 12.5×); b) Lymphocyte infiltration in the arterial medial near the false lumen (Hematoxylin and eosin staining, 100×); c) Medial necrosis in the arterial media near the false lumen (Elastica Masson-Goldner staining, 100×); d) Contraction band necrosis observed in the left anterior wall of the heart (Elastica Masson-Goldner staining, 200×)

dissection. Therefore, the medial necrosis of the aorta resulted in aortic dissection may have been triggered by the SARS-CoV-2 described above.

When the Ct values were ≥30 in living subjects, COVID-19 was not detectable using a quick antigen test, according to Yamayoshi *et al*.'s analysis of the results of RT-qPCR and rapid antigen tests [16]. Moreover, this tendency is also observed in forensic autopsy cases [4, 17]. Since the CT value in this instance was 30.78; the rapid antigen test yielded a negative result, which was inconsistent with the outcomes of the RT-qPCR experiment. According to reports, there are an average delay of 9.69 days between the onset of COVID-19 and aortic dissection [5]. Three weeks after the COVID-19 infection, Irilouzadian *et al*. [7] reported an acute type A aortic dissection. An aortic dissection case that occurred 8 days after the patient was brought to the hospital for COVID-19 was described by Tabaghi *et al*. [9]. Two of the four patients with aortitis were diagnosed after two months of the acute infection, according to Abu Hassan *et al*. [13]. This suggests that aortitis can be caused by an immune response rather than as a direct result of the virus [13].

In the present case, although the deceased had the symptom of coughing, no sign of pneumonia was observed. Additionally, the Ct value was 30.78 for the RT-qPCR result, and the CRP level was 0.06 mg/dL. According to reports, the postmortem serum CRP levels correspond to the antemortem levels [18]. Therefore, at the time of the onset of aortic dissection, the SARS-CoV-2 infection may have been asymptomatic or in the convalescent stage.

This is the first autopsy instance of aortic dissection that had a possible association with COVID-19 that we are aware of. Even though the link between aortic dissection and COVID-19 has been described in several articles, more research is required to determine the specific mechanism.

Conflict of interest

The authors declare that they have no conflict of interest.

Acknowledgments

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