Case Report

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Imaging appearance of COVID-19 Pneumonia on Magnetic Resonance Imaging (MRI) of the Chest

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Abstract

There are reports of incidental identification of Coronavirus disease 2019 (COVID-19) associated pneumonia on chest and abdominal CT scans of asymptomatic patients. However, there are few reports of incidental COVID-19 findings on cardiac or chest MRI. Since these pulmonary indicators of COVID-19 infection can be well visualized on MRI, it is essential for clinicians to recognize potential pulmonary findings on MR images.

Keywords

CT, MRI, COVID-19, SSFP

List of abbreviations

COVID-19: Coronavirus Disease 2019; MRI: Magnetic Resonance Imaging; cMRI: cardiac MRI; SSFP: Steady State Free Precession; CT: Computed Tomography; RT-PCR: Reverse Transcriptase Polymerase Chain Reaction

Introduction

The ongoing pandemic coronavirus disease 2019 (COVID-19) has substantially impacted the livelihood and well-being of virtually every person in the world. It was first described as a mysterious cause of a pneumonia observed in 27 patients in Wuhan, China in December 2019. The virus was very similar to coronaviruses that were previously isolated from bats. Later, the virus' port of cell entry was identified to be through angiotensin-converting enzyme 2 receptor (ACE-2). Utilization of this receptor was the mechanism of the SARS-CoV virus, a prior member of the coronavirus family responsible for the 2002 Severe Acute Respiratory Syndrome (SARS) and 2012 Middle Eastern Respiratory Syndrome (MERS) outbreaks. This resemblance resulted in choosing SARS-CoV-2 as the name of this new member of coronaviridae [1, 2].

With infected humans being the primary source of disease spread, rapidly diagnosing and isolating infected patients is of utmost concern both in the general population and in hospitals to protect unaffected patients and staff. The conventional reverse-transcriptase polymerase chain reaction (RT-PCR) test performed on samples from a nasopharyngeal swab is very time consuming and exhibits a high rate of false negative results. On the other hand, cross-sectional chest imaging in symptomatic patients is very specific and can confirm the diagnosis with 90% sensitivity [3].

Imaging attributes of COVID-19

Chest radiographs are a useful, rapid screening tool in centers with limited access to cross-sectional imaging and when patients cannot tolerate transfers to computed tomography (CT) scanners. In addition, routinely disinfecting CT scanner is much more time consuming and error-prone responsible X-Ray imaging which requires minimal patient contact. Reticular or nodular opacities in chest radiographs may be the early findings of infection. As the disease progresses, patchy consolidation and ground glass opacities, typically in a bilateral, peripheral, or posterior, lower zone distribution can develop. In some cases, the patient can have a complete white-out of a hemithorax or thorax. This can be secondary to confluent consolidation or pleural effusions (which tends to be rare) [4].

CT imaging has contributed significantly to the early diagnosis of COVID-19 pneumonia. These multi-planar images are capable of revealing characteristic features of the disease even when the RT-PCR is still negative in infected patients with minimal symptoms. These findings are characterized by a bilateral multifocal ground-glass appearance with air-bronchograms along the bronchovascular bundles. Multiple peripheral ground-glass consolidations identified in CT imaging is the typical indicator of COVID-19 infection [3-5].

Magnetic resonance imaging (MRI) has not been widely used for screening patients for possible COVID-19 infection due to its long acquisition time. Similar to findings in CT images, bilateral multifocal opacities have been found in MRI images as evidence of COVID-19 infection. Despite the longer acquisition time, MR imaging is strongly preferred for pregnant patients and those with contraindications for undergoing CT imaging [6, 7].

Case presentation

An 82-year-old male with a history of coronary artery disease, status post percutaneous coronary intervention of the left anterior descending and left circumflex coronary arteries, hypertension and recent thalamic hemorrhage, status post percutaneous coronary intervention of the left anterior descending and left circumflex coronary arteries, presented to the emergency room with altered mental status and was subsequently diagnosed with COVID-19 infection via nasopharyngeal RT-PCR testing. Chest CT imaging was performed upon admission and depicted extensive bilateral, peripheral ground-glass consolidations consistent with COVID-19 pneumonia (Figure 1A and 1B). After the third day of admission, the patient's troponin levels increased to 0.10 ng/ml. A cardiac MRI (cMRI) was ordered to rule out myocarditis. The cMRI was combined with an acquisition of free-breathing steady-state free-precession (SSFP) images in axial and coronal planes of the lungs (Figure 1C and 1D). Although the MRI was normal, the SSFP images demonstrated diffuse, bilateral ground-glass opacities in the lungs. These SSFP-based findings were consistent with presentations of COVID-19 related pneumonia found in the
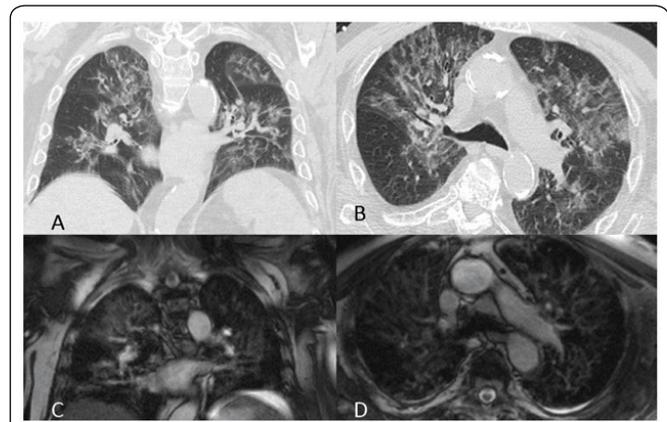

Figure 1: (A&B): Coronal and axial CT images are demonstrating extensive predominantly peripheral ground-glass consolidations in the bilateral lungs. **(C&D):** Coronal and axial SSFP images of the same patient demonstrating similar distribution of high intensity consolidations.

chest CT images of this patient.

Discussion

There are reports of incidental identification of COVID-19 associated pneumonia on chest and abdominal CT scans in asymptomatic patients [8-11], but few on cardiac or chest MRI. Given that these pulmonary findings can be well visualized on MR images, and that there are several benefits to this modality over CT imaging for certain patients, it is essential for clinicians and radiologists to recognize and carefully review MRIs for potential pulmonary indicators of COVID-19. Additionally, these findings may prompt a change in patient management and the need for cleaning of the imaging rooms in order to prevent infection of other patients as well as the hospital staff. Lastly, the described MR imaging sequence, which does not require any breath-holding and has an acquisition time of less than 10 seconds, can easily be added to MR scan protocols not primarily aimed at pulmonary imaging. Utilizing a versatile toolbox of imaging modalities and diagnostic indicators for various patient cohorts will be critical to properly triaging patients in acute settings and mitigating further spread of COVID-19.

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