COVID-19 pneumonia – Chest X-ray or CT?

V.S. Lajarin, MD; C.G.Y. Verrastro, MD; A.S. Albuquerque, MD; P. Bertolazzi, BS*; G. Meirelles, MD
Radiology Department, Fleury S.A., Paraíso, Sao Paulo, SP, Brazil
* Siemens Healthineers, Brazil

History

A 46-year-old female patient, suffering from coughing and dyspnea for the past two weeks, presented herself for a checkup. She had no fever and no history of smoking or previous pulmonary diseases. A chest CT examination was requested, based on a clinical suspicion of COVID-19 pneumonia.

Diagnosis

CT images revealed multiple ground-glass opacities (GGO) and sparse foci of consolidation in the posterior segment of both lower lobes. The extension of pulmonary involvement was, visually measured, less than 25%. Such findings, although nonspecific, were consistent with viral pneumonia. Subsequently, the patient underwent RT-PCR testing, which resulted positive for SARS-CoV-2.

Comments

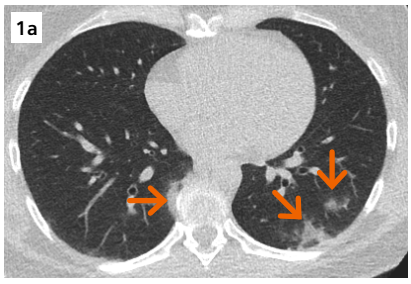
CT imaging plays an important role in the evaluation of COVID-19 pneumonia at an early stage when RT-PCR tests may be negative or unavailable – a common scenario especially in developing countries. Typical findings on a chest CT are GGO, consolidation, "crazy-paving", airways abnormalities and the reversed halo sign. These findings vary according to the stages of the infection. Chest X-ray abnormalities mirror those of CT, demonstrating bi-lateral peripheral consolidation, although less dense opacities such as ground glass may be very difficult to detect. Recent studies on COVID-19 reported a sensitivity of 69% for chest X-rays [1] and 98% for CTs.[2] CT is also applied to assess potential complications, such as viral and bacterial co-infections, pulmonary embolism or other conditions. Considering that these patients may have dyspnea, that some are young and that some may need repeated examinations as follow-ups, a quick and low-dose CT scan protocol is preferred. In this case, a so-called "Turbo Flash mode" is applied, providing ultra-fast scanning and an ultra-low radiation dose. The scanning is performed and completed in 0.46 s. This is enabled by a high pitch spiral scanning with a maximum table movement speed of 737 mm/s. A total effective dose of 0.18 mSv is achieved, which is within the dose range of a standard chest X-ray.[3] This significant dose reduction is mainly enabled by an advanced tin filter technology, which optimizes the X-ray spectra, minimizes beam-hardening artifacts and optimizes image quality by improving the air/tissue contrast. Standard dose reduction techniques, such as CARE Dose4D™ (automatic controlled tube current modulation) and ADMIRE (advanced modeled iterative reconstruction) also contribute to dose optimization.

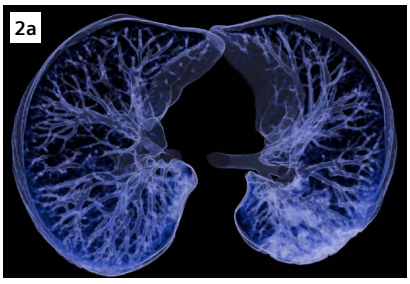
As seen in this case, chest CT scanning, using Turbo Flash mode, has clear advantages over a chest X-ray – similar radiation dose, faster speed and higher sensitivity – to evaluate COVID-19 pneumonia, even at an early stage when chest X-ray is more prone to false negative results. ●

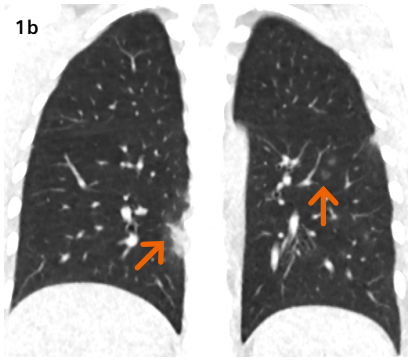
The outcomes by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.

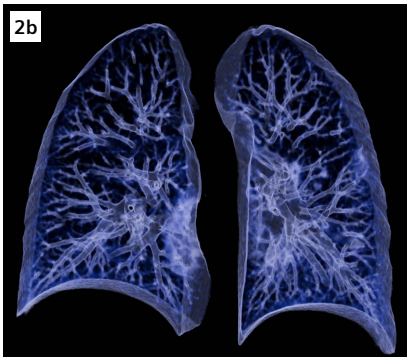
Reference

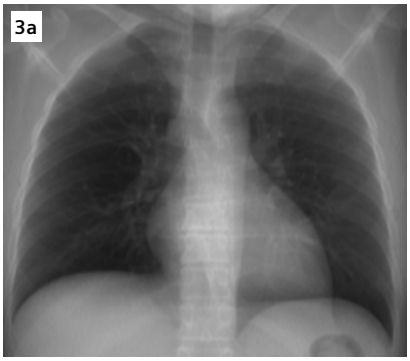
[1] Ho Yuen Frank Wong, et al. Frequency and Distribution of Chest Radiographic Findings in COVID-19 Positive Patients. Radiology. Published Online: Mar 27, 2020. https://doi.org/10.1148/radiol.2020201160.
[2] Yicheng Fang, et al. Sensitivity of Chest CT for COVID-19: Comparison to RT-PCR. Radiology. Published Online: Feb 19, 2020. https://doi.org/10.1148/radiol.2020200432.
[3] AAPM Report No. 96: The Measurement, Reporting, and Management of Radiation Dose in CT-Report of AAPM Task Group 23 of the Diagnostic Imaging Council CT Committee. http://www.aapm.org/pubs/reports/rpt_96.pdf.

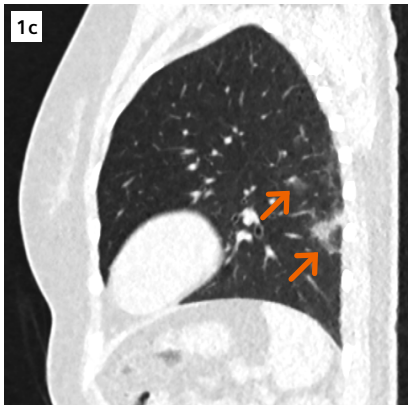


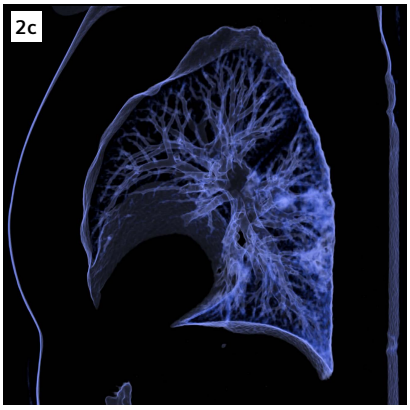


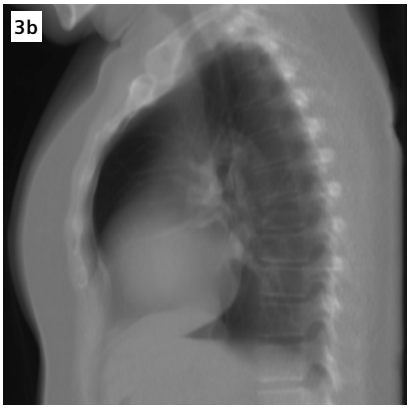












1 **Fig. 1: Axial image (Fig. 1a), coronal (Fig. 1b) and sagittal (Fig. 1c, left lung) MPR images show multiple mild patchy areas of GGO (arrows) with sparse foci of consolidation in the posterior segment of both lower lobes.**

2 **Fig. 2: Axial (Fig. 2a), coronal (Fig. 2b) and sagittal (Fig. 2c, left lung) views of VRT images demonstrate the corresponding areas in three dimensions.**

3 **Fig. 3: Simulation of an anterior-posterior (AP, Fig. 3a) and a lateral (L, Fig. 3b) chest X-ray, using CT images (MPR Thick reconstruction), suggest difficult or impossible visualization of the GGO due to overlapping with the heart or spine and mild density change.**

Examination Protocol

Scanner	SOMATOM Force
Scan area	Thorax
Scan mode	Turbo Flash mode
Scan length	331.6 mm
Scan direction	Caudo-cranial
Scan time	0.46 s
Tube voltage	Sn100 kV
Effective mAs	96 mAs
Dose modulation	CARE Dose4D
$CTDI_{vol}$	0.34 mGy

DLP	12.5 mGy cm
Effective dose	0.18 mSv
Rotation time	0.25 s
Pitch	2.9
Slice collimation	2 x 96 x 0.6 mm
Slice width	1 mm
Reconstruction increment	0.7 mm
Reconstruction kernel	Br40/Br54 (ADMIRE 3)