

Sensitivity of Chest CT for COVID-19: Comparison to RT-PCR

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Summary statement: In a series of 51 patients with chest CT and RT-PCR assay performed within 3 days, the sensitivity of CT for COVID-19 infection was 98% compared to RT-PCR sensitivity of 71% ($p < .001$).

Introduction

In December 2019, an outbreak of unexplained pneumonia in Wuhan [1] was caused by a new coronavirus infection named COVID-19 (Corona Virus Disease 2019). Noncontrast chest CT may be considered for early diagnosis of viral disease, although viral nucleic acid detection using real-time polymerase chain reaction (RT-PCR) remains the standard of reference. Chung et al. reported that chest CT may be negative for viral pneumonia of COVID-19 [2] at initial presentation (3/21 patients). Recently, Xie reported 5/167 (3%) patients who had negative RT-PCR for COVID-19 at initial presentation despite chest CT findings typical of viral pneumonia [3]. The purpose of this study was to compare the sensitivity of chest CT and viral nucleic acid assay at initial patient presentation.

Materials and Methods

The retrospective analysis was approved by institutional review board and patient consent was waived. Patients at Taizhou Enze Medical Center (Group) Enze Hospital were evaluated from January 19, 2020 to February 4, 2020. During this period, chest CT and RT-PCR (Shanghai ZJ Bio-Tech Co, Ltd, Shanghai, China) was performed for consecutive patients who presented with a history of 1) travel or residential history in Wuhan or local endemic areas or contact with individuals with individuals with fever or respiratory symptoms from these areas within 14 days and 2) had fever or acute respiratory symptoms of unknown cause. In the case of an initial negative RT-PCR test, repeat testing was performed at intervals of 1 day or more. Of these patients, we included all patients who had both noncontrast chest CT scan (slice thickness, 5mm) and RT-PCR testing within an interval of 3 days or less and who had an eventual confirmed diagnosis of COVID-19 infection by RT-PCR testing (Figure 1). Typical and atypical chest CT findings were recorded according to CT features previously described for COVID-19 (4,5). The detection rate of COVID-19 infection based on the initial chest CT and RT-PCR was compared. Statistical analysis was performed using McNemar Chi-squared test with significance at the $p < .05$ level.

Results

51 patients (29 men and 22 women) were included with median age of 45 (interquartile range, 39- 55) years. All patients had throat swab (45 patients) or sputum samples (6 patients) followed by one or more RT-PCR assays. The average time from initial disease onset to CT was 3 +/- 3 days; the average time from initial disease onset to RT-PCR testing was 3 +/- 3 days. 36/51 patients had initial positive RT-PCR for COVID-19. 12/51 patients had COVID-

19 confirmed by two RT-PCR nucleic acid tests (1 to 2 days), 2 patients by three tests (2-5 days) and 1 patient by four tests (7 days) after initial onset.

50/51 (98%) patients had evidence of abnormal CT compatible with viral pneumonia at baseline while one patient had a normal CT. Of 50 patients with abnormal CT, 36 (72%) had typical CT manifestations (e.g. peripheral, subpleural ground glass opacities, often in the lower lobes (Figure 2) and 14 (28%) had atypical CT manifestations (Figure 3) [2]. In this patient sample, difference in detection rate for initial CT (50/51 [98%, 95% CI 90-100%]) patients was greater than first RT-PCR (36/51 [71%, 95%CI 56-83%]) patients ($p<.001$).

Discussion

In our series, the sensitivity of chest CT was greater than that of RT-PCR (98% vs 71%, respectively, $p<.001$). The reasons for the low efficiency of viral nucleic acid detection may include: 1) immature development of nucleic acid detection technology; 2) variation in detection rate from different manufacturers; 3) low patient viral load; or 4) improper clinical sampling. The reasons for the relatively lower RT-PCR detection rate in our sample compared to a prior report are unknown (3). **Our results support the use of chest CT for screening for COVID-19 for patients with clinical and epidemiologic features compatible with COVID-19 infection particularly when RT-PCR testing is negative.**

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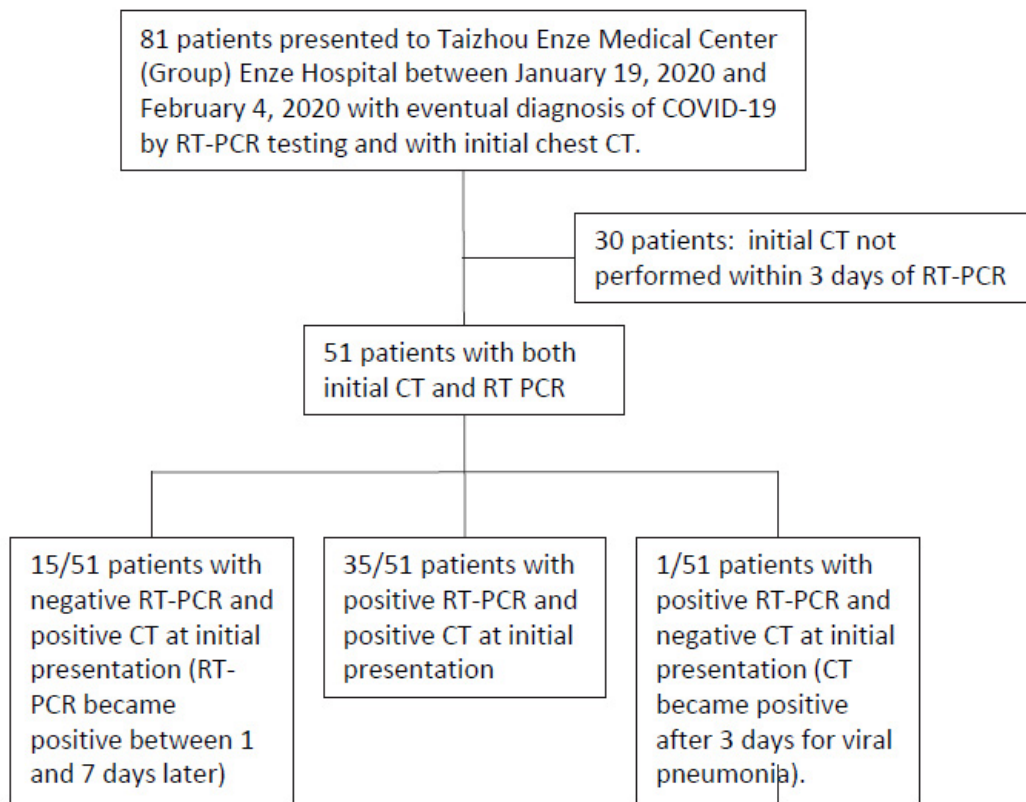


Figure 1: Flowchart for patient inclusion.

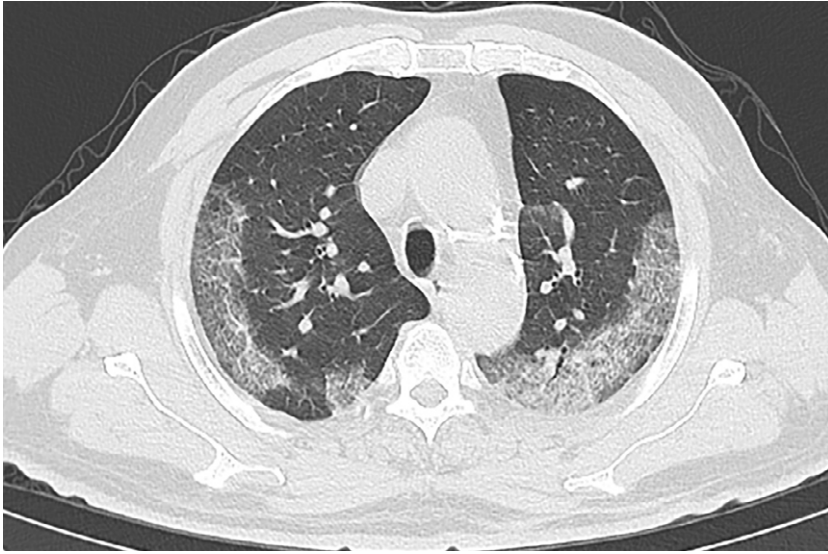


FIG 2A

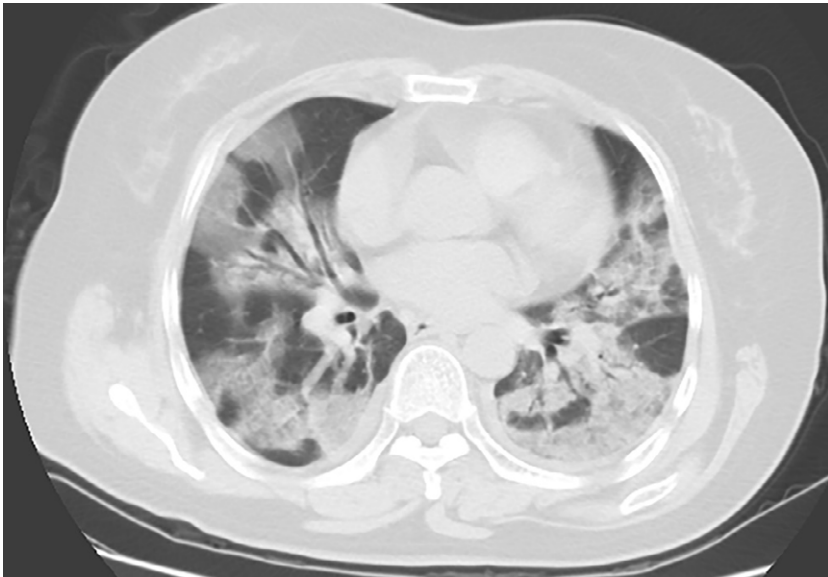


FIG 2B

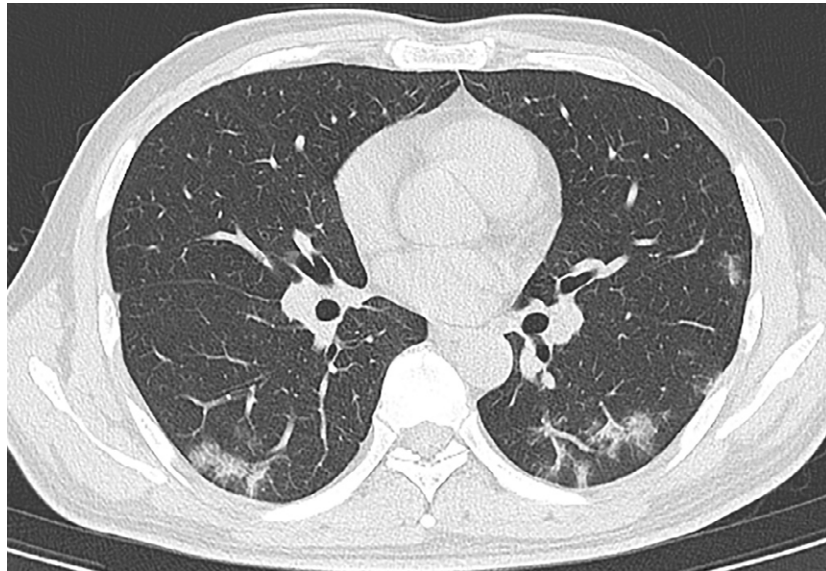


FIG 2C

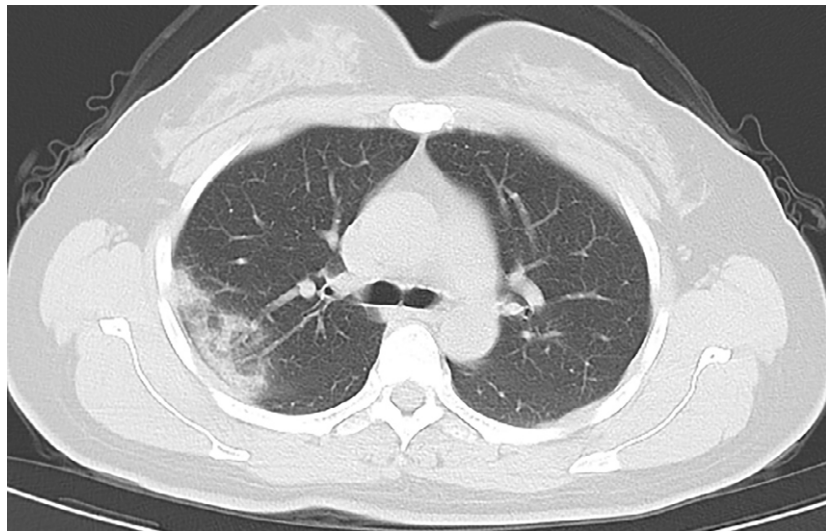


FIG 2D

Figure 2: Examples of typical chest CT findings compatible with COVID-19 pneumonia in patients with epidemiological and clinical presentation suspicious for COVID-19 infection. A, male, 74 years old with fever and cough for 5 days. Axial chest CT shows bilateral subpleural ground glass opacities (GGO). B, female, 55 years old, with fever and cough for 7 days. Axial chest CT shows extensive bilateral ground glass opacities and consolidation; C, male, 43 years old, presenting with fever and cough for 1 week. Axial chest CT shows small bilateral areas of peripheral GGO with minimal consolidation; D, female, 43 years old presenting with fever with cough for 5 days. Axial chest CT shows a right lung region of peripheral consolidation.

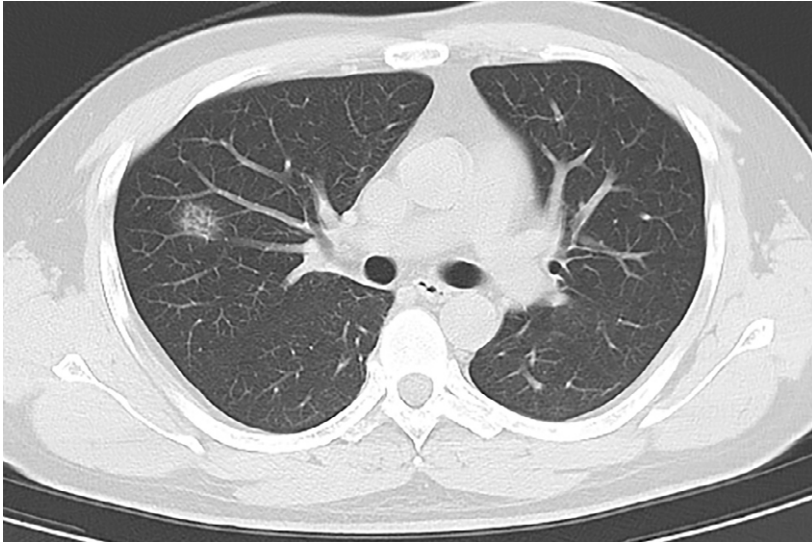


FIG 3A

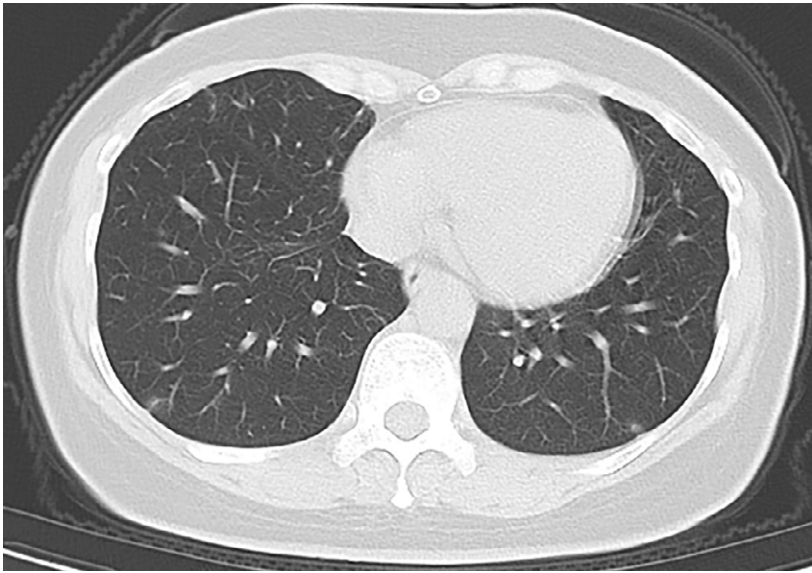


FIG 3B

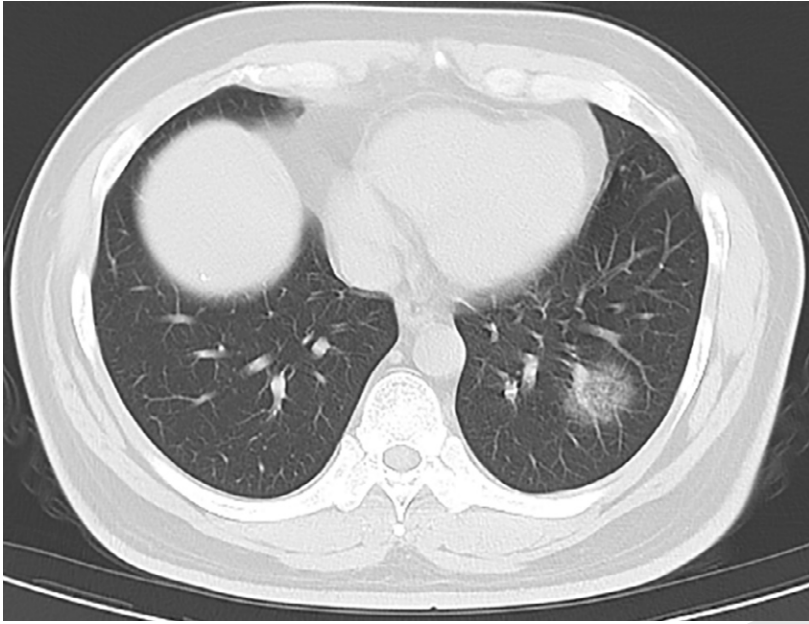


FIG 3C

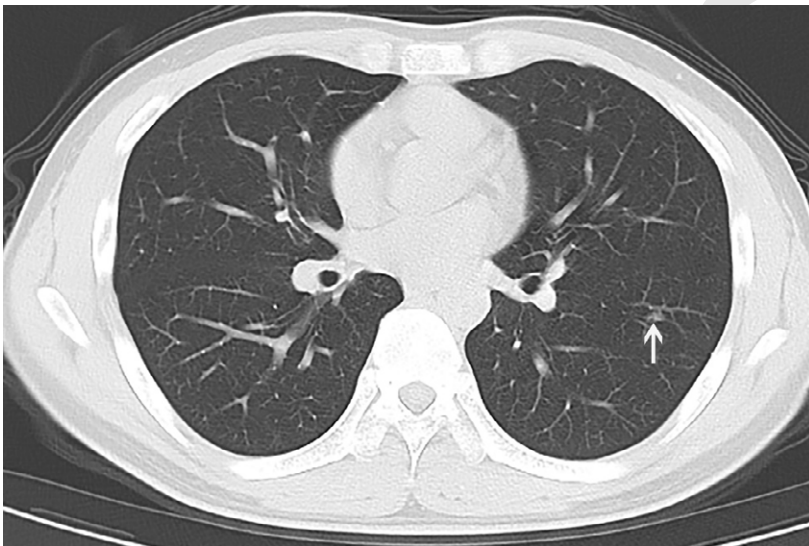


FIG 3D

Figure 3: Examples of chest CT findings less commonly reported in COVID-19 infection (atypical) in patients with epidemiological and clinical presentation suspicious for COVID-19 infection. A, male, 36 years old with cough for 3 days. Axial chest CT shows a small focal and central ground glass opacity (GGO) in the right upper lobe; B, female, 40 years old. Axial chest CT shows small peripheral linear opacities bilaterally. C, male, 38 years old. Axial chest CT shows a GGO in the central left lower lobe; D, male, 31 years old with fever for 1 day. Axial chest CT shows a linear opacity in the left lower lateral mid lung.