CT Scans Obtained for Nonpulmonary Indications: Associated Respiratory Findings of COVID-19

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Abstract

Background: Atypical manifestations of COVID-19 are being encountered as the pandemic unfolds, leading to non-chest CT scans that may uncover unsuspected pulmonary disease.

Purpose: To investigate patients with primary non-respiratory symptoms who underwent abdomen/pelvis or cervical spine/neck CT with unsuspected findings highly suspicious for pulmonary COVID-19.

Materials and Methods: This retrospective study from March 10, 2020 to April 6, 2020 involved three institutions, two in a region considered a hotspot (area of high prevalence) for COVID-19. Patients without known COVID-19 were included who presented to the emergency room (ER) with primary non-respiratory [gastrointestinal (GI) or neurological] symptoms, had lung parenchymal findings suspicious for COVID-19 on a non-chest CT but no concurrent chest CT and had COVID-19 testing in the ER. Group 1 patients had RT PCR obtained pre-CT read (COVID-19 suspected on presentation); Group 2 had RT PCR obtained post-CT read (COVID-19 not suspected). Presentation and imaging findings were compared and outcomes were evaluated. Descriptive statistics and Fisher exact tests were used for analysis.

Results: Group 1 comprised 62 patients [31 men, 31 women, mean age 67(SD ±17) years] and group 2 comprised 57 patients [28 men, 29 women, mean age 63(SD ± 16) years). Cough and fever were more common in group 1 (37/62, 60%, 29/62, 47%) than group 2 (9/57, 16%, 12/57, 21%) respectively, with no significant difference in the remaining symptoms. There were 101 abdomen/pelvis and 18 cervical spine/neck CTs. In Group 1, non-chest CT findings provided the initial evidence of COVID-19 related pneumonia in 32/62 (52%); for Group 2, it was 44/57 (77%). Overall, the most common CT findings were ground glass opacity (114/119, 96%) and consolidation (47/119,40%). 29/119 (24%) patients required major interventions (vasopressor medication or intubation) and 27/119 (23%) died. Patients who underwent cervical spine/neck CT had worse outcomes than those with abdominal/pelvic CT (p =0.01).

Conclusion: In a substantial percentage of patients with primary non-respiratory symptoms who underwent non-chest CT, the CT provided the first evidence of COVID-19 related pneumonia.

Key Results:

1. The presence of pneumonia in the visualized lung parenchyma was established based on non-chest CT scan in 76/119 (64%) of patients and led to a COVID-19 diagnosis in 44/119 (37%) of patients.
2. Overall, patients diagnosed with COVID-19 presenting with primary non-respiratory symptoms often had poor outcomes, developing severe symptoms requiring major interventions and, in many cases, ultimately died (23%).

Summary Statement: Radiologists should maintain a high index of suspicion with respect to the lungs in patients with primary extra-pulmonary clinical symptoms who undergo non-chest CT studies to facilitate earlier diagnosis of COVID-19 related pneumonia.
Introduction:
The novel coronavirus disease (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), initially centered in Hubei Province of People’s Republic of China at the end of December 2019 is now the cause of a major pandemic. The most common presenting symptoms consist of fever, cough, nasal congestion, fatigue and other signs of respiratory tract infection (1). In some patients, these symptoms may progress to chest pain, shortness of breath, and dyspnea with pneumonia (1).

Symptoms of SARS-CoV-2 resemble those of the severe acute respiratory syndrome coronavirus (SARS-CoV) in 2003 and Middle East respiratory syndrome (MERS-CoV) in 2012. There is growing evidence that CoV infections may share similar pathways and mechanisms. SARS-CoV-2 enters the human host cell via angiotensin-converting enzyme 2 (ACE2) receptor, which can be found in human lung parenchyma, airway epithelium, vascular endothelium, kidney cells and small intestines (2). MERS-CoV infection uses dipeptidyl peptidase 4 (DPP4), to enter the human cell and can be found in the lower respiratory tract, kidney, small intestine, liver and immune system cells (2). Therefore, in addition to pulmonary manifestations, patients with COVID-19 may present with atypical symptoms such as neurological and gastrointestinal (GI) symptoms.

It has been reported that nearly 20% of patients with COVID-19 present with GI symptoms including vomiting, diarrhea, and abdominal pain (3). Gu et al and Han et al described a small percentage of COVID-19 patients who presented only with digestive symptoms or digestive symptoms which preceded their respiratory symptoms (4, 5). Patients who present solely with GI symptoms are more likely to be undiagnosed, and remain in their community posing a continued infectious risk to the population.
There are several case reports of individuals presenting solely with neurological symptoms related to COVID-19, such as altered mental status, diminished sense of smell and taste, headache, confusion, strokes, and seizures with encephalitis-like symptoms (6). In Italy, dedicated Neuro-COVID units caring for patients presenting with neurological deficits have been established (7).

Patients not known to be COVID-19 positive who have either gastrointestinal or neurological symptoms may undergo cross-sectional imaging, which will include portions of the lung out of necessity. In this study, we evaluated patients not known to be COVID-19 positive who presented to the emergency room (ER) with substantial non-respiratory symptoms, who underwent CT of the abdomen/pelvis, or cervical spine/neck (in conjunction with head CT and who were noted to have findings suspicious for COVID-19 pneumonia in the imaged lungs.

**Materials and Methods**

*Study Design and Patients*

The institutional review board approved this retrospective multi-center study and written informed consent was waived. Montefiore Medical Center (site 1) and Mount Sinai Medical Center (site 2) were located in a COVID-19 hotspot (high disease prevalence region) (at the time of the study, New York City on 3/31 - 541 cases per 100,000) and University of Maryland Medical System (site 3) was situated in a location where the disease was less prevalent (36 cases per 100,000 population on 3/31) and not considered overwhelming (8). The study extended from March 10, 2020 - April 6, 2020; sites one and three investigated patients over
the entire period and site 2, investigated dates from March 22, 2020 – March 29, 2020, due to limited resources during this pandemic.

At each site, the medical record was queried for all patients during the target time frame whose primary symptoms were non-respiratory, who underwent ER CT scan of the abdomen/pelvis or CT of the cervical spine/neck (i.e. a non-chest CT scan). Patients who had concurrent chest CT were excluded, as were those with a diagnosis of COVID-19 prior to presentation in the ER. All patients underwent RT PCR during ER admission. A review of final interpretations was performed and patients with lung parenchymal findings suspicious for pneumonia were recorded. The medical record was reviewed to determine timing of non-chest CT report relative to obtaining the RT PCR (Abbott laboratories, Abbott Park, IL and Roche Diagnostics, Basel, Switzerland). The patients were divided into two groups. Group 1 comprised patients in whom RT PCR was obtained prior to the non-chest CT report – deemed to have high suspicion for COVID-19 at presentation. Group 2 comprised patients in whom RT PCR was obtained following the non-chest CT report– judged to be at low or no suspicion for COVID-19 prior to that report. Based on this methodology, group 1 comprised of 66 patients [31 men, 31 women, mean age 67(SD ± 17) years, group 2 comprised of 57 patients [28 men, 29 women, mean age 63(SD ± 16) years. A total of 119 patients [59 men, 60 women, mean age 65(SD ±16) years formed the final assessment cohort (See Figure 1 flowchart).

CT Protocol

CT was performed on a commercial MDCT (Siemens SOMATOM, Siemens, Tokyo, Japan or GE 64 slice CT scanner, GE Medical Systems, Milwaukee, WI, USA) with or without contrast. For CT
acquisition, tube voltage was 120 kV with automatic tube current modulation, maximum 600 mA. Acquisition parameters were modified to minimize patient radiation exposure while maintaining sufficient resolution. All studies were reconstructed with slice thickness \( \leq 4 \text{ mm} \) using a lung reconstruction kernel.

**Image Analysis**

The reports of the original interpreting physicians were reviewed to determine if they described findings of pneumonia on the non-chest CT. In addition, CT scans of COVID-19 positive patients were re-reviewed by five radiologists (RH (4 years), ML (2 years), JA (1 year), BZ (17 years), CW (29 years)) to provide a more uniform characterization of the pulmonary findings based on use of a common spreadsheet. Four of five radiologists were fellowship trained in cardiothoracic imaging. A single radiologist evaluated each CT scan and each was blinded to the initial radiologic report. Parameters evaluated included: the presence or absence of ground-glass opacity (GGO), consolidation, crazy-paving, and central vs peripheral distribution. Severity of the parenchymal findings were also graded as mild (1-25%), moderate (26-50%), and severe (> 51%) involvement of the visualized lungs. Other features such as pleural effusion, pleural thickening, bronchiectasis, and air trapping were also recorded.

The medical record was reviewed for both groups 1 and 2 patients to assess if patients had undergone chest radiography at the time of the ER visit. If the chest radiograph was obtained prior to the non-chest CT and was interpreted as showing pneumonia, the patient was deemed to have a diagnosis of COVID-19 related pneumonia on the basis of the chest radiograph, and not on the basis of the non-chest CT.
In contrast, if no chest radiograph was obtained during the ER visit, the chest radiograph was obtained following the non-chest CT or the chest radiograph obtained prior to the CT was not diagnostic of pneumonia (i.e. interpreted as negative or with a nonspecific finding such as atelectasis), the patient was deemed to have a diagnosis of COVID-19 related pneumonia on the basis of the non-chest CT (determination was made based on a subsequent positive RT PCR). For the CT to be considered the basis for diagnosing COVID-19, the original CT interpretation was required to describe findings consistent with pneumonia, although not necessarily explicitly COVID-19 pneumonia. The percentage of patients in groups 1 (COVID-19 suspected) and 2 (COVID-19 unsuspected) whose diagnosis of COVID-19 related pneumonia was based on the CT was calculated.

In addition, we reviewed the final interpretations of the abdominal/pelvis and cervical spine/neck CTs to determine if there were findings corresponding to the indications for these studies.

**Outcomes Data**

We extracted demographic data, clinical characteristics including respiratory symptoms, neurological and gastrointestinal symptoms on admission. Treatments and clinical outcomes (including discharge from the emergency room, admission, leaving against medical advice, do not resuscitate/ do not intubate (DNR/DNI) status, necessity for major interventions such as vasopressor or intubation, or death) were documented.
**Statistical Analysis**

Statistical analyses were performed using R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Continuous variables were presented as mean +/- standard deviation. Categorical variables were presented as frequencies and percentages. The comparisons of categorical data were performed using Fisher’s exact test and odds ratios were calculated. Statistical significance level was set at p <0.05.

**Results**

Among patients who had lung abnormalities on non-chest CT, COVID-19 related pneumonia was significantly more common among institutions in the hotspot area as compared to the institution in the non-hotspot area [(46.6% (119/255) hotspot vs 3.2 % (2/62) non-hotspot (P< 0.001))] Demographics and clinical characteristics of the study population are summarized in Table 1. Group 1 comprised 62 patients [31 men, 31 women, mean age 67(SD ±17) years] and Group 2 comprised 57 patients [28 men, 29 women, mean age 63(SD ± 16) years. In group 1, there were 53 abdomen/pelvis CT scans and 9 cervical spine/neck CT scans; in group 2, 48 abdomen/pelvis CT scans and 9 cervical spine/neck CT scans.

Cough and fever were more common in group 1 (37/62, 60% vs 9/57, 16% (p<0.001)), (29/62, 47% vs 12/57, 21% (p<0.004)) in comparison to group 2, respectively. For flu-like, nausea/vomiting/diarrhea, and neurological symptoms, there was no significant difference (Table 1).
Imaging findings

In group 1 (suspected COVID-19 patients), the diagnosis of COVID-19-related pneumonia was established based on CT scan in 32/62 (52%) patients. In group 2 (patients not initially suspected of COVID-19) the diagnosis of pneumonia (confirmed to be COVID-19 related after RT PCR was obtained) was established based on CT scan in 44/57 (77%) patients (Table 2). Overall, non-chest CT established the diagnosis of COVID-19 related pneumonia in 76/119 (64%) and led ultimately to an unsuspected COVID-19 diagnosis in 44/119 (37%). 111/119, 93% of abnormal lung findings on non-chest CT studies were described as suspicious by the original interpreting radiologist.

The lung findings based on the retrospective evaluation of all 101 CT scans of the abdomen/pelvis and 18 CTs of the cervical spine/neck are summarized in Figure 2. Among the CT findings, peripheral ground glass opacities were most common (114/119, 96%) followed by consolidation (47/119, 40%) and crazy-paving (27/119, 23%). 60 (50%) patients had mild CT disease vs. 36 (30%) patients who demonstrated moderate disease, and 23(19%) with severe involvement (Figure 3). Air-trapping was present in 6/119 (5.0%) of patients and bronchiectasis was noted in 8/119 (6.7%) patients. Pleural effusions were noted in 13/119 patients (11%) and pleural thickening in 8/119 (6.7%). Examples from an abdomen/pelvis CT (Figure 4) and cervical spine CT (Figure 5) are shown.

With respect to the findings for which the non-chest CTs were originally ordered, no acute/significant findings were seen on 69/101, 68% of abdominal/pelvic CTs. The top three findings on abdominal/pelvic CT directly related to the indications for the study were
enteritis/colitis (7/32, 22%), renal calculi (5/32, 16%), and pancreatitis (3/32, 9.4%). No acute/significant findings were identified on 16/18, 89% of cervical spine/neck CTs. The two significant findings on the cervical spine/neck CT were internal carotid artery occlusion and moderate left internal carotid artery occlusion.

**Outcomes**

Twenty-three (19%) patients were discharged directly from the emergency room with referral for self-isolation. Three patients left against medical advice after their COVID-19 diagnosis, and the remaining 93 (78%) patients were admitted. 29 (24%) patients required major interventions such as vasopressors or intubation, 19 (20%) patients were placed in a DNR/DNI status, and 27 (23%) patients died during the hospital admission.

A poor outcome as defined by the need for major intervention such as vasopressors or intubation or death during hospital admission occurred in 24% (29/119) of our cohort. There was no statistical difference between increased density of parenchyma (consolidation and/or ground glass opacity) and poor outcomes. In addition, there was no statistical difference between CT severity based on a score of mild vs moderate/severe and poor outcomes. However, patients who underwent cervical spine/neck CT had worse outcomes in comparison to those who had abdominal/pelvic CT (p=0.01).
Discussion

In this study, we found that in a substantial percentage of patients who presented to the ER primarily with GI or neurological symptoms, the presence of pneumonia in the visualized lungs on the resultant abdomen/pelvis or cervical spine/neck CT was unsuspected in 63.9% of the cases. In addition, COVID-19 positive status was ultimately established based on the non-chest CT in 37% of patients. In most patients, there was no specific abdominal or neurological finding on CT to account for the symptoms that led to the study.

To our knowledge, this is the largest study to evaluate diagnosis of pulmonary COVID-19 findings on non-chest CT scans in patients presenting with non-primary respiratory symptoms, and the first to include patients with primary neurological symptoms. Two recent studies have been published in patients presenting with abdominal symptoms who had imaging findings suggestive of COVID-19 in the lung bases, the largest report consisting of 23 patients undergoing abdominal CT that retrospectively evaluated the findings in the lungs but not their impact on diagnosis. (9, 10).

Our study highlights the importance of evaluating lung imaging findings on non-chest CT scans, both at the lung bases or apices as they may suggest COVID-19 positivity and be the initial indication of COVID related pneumonia, particularly in high disease prevalence areas. Earlier diagnosis in patients with unsuspected COVID-19 with atypical symptoms based on these CT findings allows for more rapid triage and presumably improvement in their management. Additionally, due to the inherent stress on medical resources during the pandemic, appreciation of such features may facilitate rapid confirmation of COVID-19 status with RT PCR testing.
In our study of 101 abdominal/pelvic and 18 cervical spine/neck CTs acquired in patients presenting with primary non-respiratory symptoms, vague flu-like symptoms were present in the majority (61/119, 51.3%). 27 (22.7%) patients ultimately died during this hospital admission. In particular, patients who underwent CT of the cervical spine/neck were more likely to die (p=0.004).

While most patients with COVID-19 present with respiratory symptoms, there have been several reports of patients with predominant GI symptoms. Gu et al reported 99/206 (46%) COVID-19 positive patients presented with digestive tract symptoms including: anorexia (83.8%), diarrhea (29.3%), vomiting (8.1%), and abdominal pain (4%) (4). A small percentage of patients (3%) presented solely with digestive tract symptoms. GI symptoms can manifest early in the disease course of COVID-19 patients, and it has been reported that diarrhea may be the only initial symptom, preceding respiratory symptoms in some cases (11). SARS-CoV-2 RNA has also been identified in stool specimens and rectal/anal swab specimens (12, 13). Han et al reported 206 patients with digestive symptoms who tested positive for COVID-19 RNA in the stool, and found they experienced longer delay in viral clearance, as well as longer time to diagnosis compared to those presenting only with respiratory symptoms (5).

Reports of neurological manifestations of COVID-19 are being published with increasing frequency. In the United States, a case report of acute necrotizing encephalopathy secondary to COVID-19 was reported in a female airline worker presenting with fever, cough and altered mental status (14). In a study by Mao et al, neurological symptoms were present in 78 of 214 (36.4%) COVID-19 positive patients and were more common in patients with severe respiratory infection (6). These neurological symptoms were divided into three categories- central nervous
system, peripheral nervous system, and skeletal muscular symptoms. The authors concluded that in comparison to non-severe respiratory infection, COVID-19 patients with severe infection commonly develop neurological symptoms such as acute cerebrovascular disease (5 [5.7%] vs 1 [0.8%]), impaired consciousness (13 [14.8%] vs 3 [2.4%]) and skeletal muscle injury (17 [19.3%] vs 6 [4.8%]) (6). Thus, it is not surprising that such patients who later prove to have COVID-19 may initially be referred for cross-sectional imaging outside the chest.

In our study, most patients had GGO (95.8%) followed by consolidation (39.5%) in the imaged lungs. This is similar to findings reported for patients who undergo dedicated chest CT for COVID-19 in the early phases of the disease. Other less frequent findings such as air-trapping, bronchiectasis, crazy paving, pleural effusion/thickening were not commonly present. These have also been noted with less frequency (or are absent) in the COVID-19 chest CT literature (15).

In our cohort of patients diagnosed with COVID-19 pneumonia, the mortality rate was 22.7%. This is lower in comparison to other studies of patients with COVID-19 pneumonia presenting with respiratory symptoms, in which in-hospital mortality ranged from 28-67%. (16, 17). The reason for the lower mortality rate is unclear but may be due to overall less severe pulmonary symptoms in our group as well as differences in our study populations. In addition, some patients remain hospitalized at the time of publication and their outcomes remain indeterminate.

Patients presenting with primarily non-respiratory symptoms such as neurological and GI symptoms may be triaged differently than those suspected to have COVID-19. Thus, radiologists
may not be focused on the possibility of that diagnosis when abnormalities are encountered in lung parenchyma adjacent to the area of interest. Knowledge and awareness of pulmonary imaging manifestations of COVID-19 present on non-chest CT scans is important. As the number of COVID-19 cases continues to rise globally, clinicians and radiologists must have a high degree of suspicion when evaluating the lungs on non-chest CT scans of patients presenting with primary non-respiratory symptoms as a potential initial presentation of COVID-19 even in patients in whom COVID-19 is suspected. These imaging findings may not only impact immediate patient care, but also help mitigate public transmission of the disease. In addition, such unsuspected findings should be a catalyst for immediate action including notification of the ordering clinician, isolation and testing of the patient, communication to all members involved in the patient’s care, as well as decontamination of the imaging service area.

This study is limited by its retrospective nature that may have led to selection bias. In addition, one site investigated a shorter time frame than the entire time span due to scarcity of available resources in the middle of a pandemic. However, the selected time frame was in the center of the entire time frame to provide the best approximation. A further limitation is that in the retrospective evaluation, each study was reviewed by a single reviewer although all reviewers had substantial experience with chest CT and the appearance of COVID-19 related lung findings. Each patient in our cohort was confirmed COVID-19 positive by RT PCR testing either before or after the non-chest CT but it is known that such testing falls short of 100% sensitivity and specificity. While some patients reported a history of cough at presentation, this was not the primary nor the most concerning symptom reported by the patient, and therefore in many
cases it was the abdominal/pelvis or cervical spine/neck CT that was critical to establishing the diagnosis.

In summary, radiologists should maintain a high index of suspicion with respect to the lungs in patients with primary extra-pulmonary clinical symptoms who undergo non-chest CT studies of adjacent body parts to facilitate earlier diagnosis of COVID-19 related pneumonia during the current pandemic. These patients demonstrate typical pulmonary findings of COVID-19 at the upper or lower margins of the scan, most commonly peripheral GGO, followed by consolidation.

Acknowledgements: We would like to thank our families for their support and the health care workers on the front lines of this current pandemic.

References:


Table 1: Demographics and clinical characteristics of the COVID-19 population with lung disease on non-CT scans.

<table>
<thead>
<tr>
<th>Patient Demographics</th>
<th>All Patients (n=119)</th>
<th>Group 1 (RT PCR before CT) (n=62)</th>
<th>Group 2 (RT PCR after CT) (n=57)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age years (range)</td>
<td>65 ± 16.1 (23-98)</td>
<td>67 ± 16.6 (23-98)</td>
<td>63.1 ± 15.5 (24-89)</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>59 (49.6%)</td>
<td>31 (50%)</td>
<td>28 (49.1%)</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>60 (50.4%)</td>
<td>31 (50%)</td>
<td>29 (50.9%)</td>
<td></td>
</tr>
<tr>
<td>CT cervical spine/neck</td>
<td>18 (15.1%)</td>
<td>9 (14.5%)</td>
<td>9 (14.5%)</td>
<td></td>
</tr>
<tr>
<td>CT abdomen/pelvis</td>
<td>101 (84.9%)</td>
<td>53 (85.5%)</td>
<td>48 (84.2%)</td>
<td></td>
</tr>
<tr>
<td><strong>Signs/Symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flu-like</td>
<td>61 (51.3%)</td>
<td>35 (56.5%)</td>
<td>26 (45.6%)</td>
<td>0.27</td>
</tr>
<tr>
<td>Nausea/vomiting/diarrhea</td>
<td>60 (50.4%)</td>
<td>35 (56.5%)</td>
<td>25 (43.9%)</td>
<td>0.20</td>
</tr>
<tr>
<td>Cough</td>
<td>46 (38.7%)</td>
<td>37 (59.7%)</td>
<td>9 (15.8%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Fever</td>
<td>41 (34.4%)</td>
<td>29 (46.8%)</td>
<td>12 (21.1%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Neurological</td>
<td>34 (28.6%)</td>
<td>18 (29%)</td>
<td>16 (28.1%)</td>
<td>1.000</td>
</tr>
<tr>
<td><strong>Hospital Course</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharged from Emergency Room</td>
<td>23 (19.3%)</td>
<td>13 (21%)</td>
<td>10 (17.5%)</td>
<td>0.65</td>
</tr>
<tr>
<td>Admitted</td>
<td>93 (78.2%)</td>
<td>48 (77.4%)</td>
<td>45 (78.9%)</td>
<td>1.00</td>
</tr>
<tr>
<td>Left against medical advice</td>
<td>3 (2.5%)</td>
<td>1 (1.6%)</td>
<td>2 (3.5%)</td>
<td>0.60</td>
</tr>
<tr>
<td>Required increased intervention</td>
<td>29 (24.4%)</td>
<td>12 (19.4%)</td>
<td>17 (29.8%)</td>
<td>0.53</td>
</tr>
<tr>
<td>Death</td>
<td>27 (22.7%)</td>
<td>12 (19.4%)</td>
<td>15 (26.3%)</td>
<td>0.83</td>
</tr>
</tbody>
</table>
Table 2: Diagnosis of COVID-19 pneumonia based on imaging modality.

<table>
<thead>
<tr>
<th></th>
<th>RT PCR before CT (Group 1)</th>
<th>RT PCR after CT (Group 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia diagnosed by CT</td>
<td>32*</td>
<td>44~</td>
</tr>
<tr>
<td>Pneumonia diagnosed by CXR</td>
<td>30</td>
<td>13</td>
</tr>
</tbody>
</table>

* the diagnosis of COVID-19 pneumonia was established based on CT scan in a COVID-19 suspected patient.
* the diagnosis of COVID-19 pneumonia was established based on CT scan in a patient not suspected of having COVID-19.
CT abdomen/pelvis, neck and cervical spine screened for eligibility between:
March 10 - April 6: Site 1 (n = 1195)
March 22 - March 29: Site 2 (n = 611)
March 10 - April 6: Site 3 (n = 1009)
(Total n = 2815)

Positive CT lung base/apical findings suggesting pneumonia (n = 299)

Excluded (n = 2516)
- Concurrent CT chest due to respiratory symptoms
- Absent lung parenchymal findings
- Prior history of positive COVID-19 test

RT PCR COVID-19 Positive (n = 119)

RT PCR COVID-19 Negative (n = 180)

Group 1: RT PCR for COVID-19 ordered BEFORE CT results (n = 62)
(53 abdominal/pelvic CTs, 9 neck/cervical spine CT)

Group 2: RT PCR for COVID-19 ordered AFTER CT results (n = 57)
(48 abdominal/pelvic CTs, 9 neck/cervical spine CT)

Figure 1: Flow chart of the study.
Figure 2: Diagram of lung parenchymal findings present on non-chest CT scan.
Figure 3: Graph of severity of parenchymal findings on CT scan.
Figure 4: A 33-yr man presenting with right lower quadrant abdominal pain, found to have acute appendicitis on abdominal/pelvic CT. Axial (a) and coronal (b) views on lung windows demonstrate focal peripheral ground glass opacity in the right lung base.
Figure 5: An 84-yo man with dementia and history of CVA presenting with altered mental status and unwitnessed fall. Axial cervical spine CT on lung windows demonstrate partially visualized left upper lobe peripheral mixed consolidative and ground glass opacities.