

Unexpected Findings of Coronavirus Disease (COVID-19) at the Lung Bases on Abdominopelvic CT

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OBJECTIVE. The purpose of this study is to report unanticipated lung base findings on abdominal CT in 23 patients concerning for coronavirus disease (COVID-19). In these patients, who were not previously suspected of having COVID-19, abdominal pain was the most common indication for CT ($n = 19$), and 11 patients had no extrapulmonary findings. Seventeen patients underwent polymerase chain reaction testing, which returned positive results for all 17.

CONCLUSION. Unsuspected coronavirus disease may be strongly suggested on the basis of lung findings on abdominopelvic CT.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a novel strain of coronavirus causing severe acute respiratory syndrome in a small number of infected patients, was initially identified in December 2019 in Wuhan City, China [1]. The resulting pneumonia was called coronavirus disease (COVID-19). As of April 3, 2020, more than 1,060,000 cases of COVID-19 were reported worldwide, with more than 258,000 cases in the United States and more than 102,000 cases in New York State [2].

Although patients with COVID-19 typically present with fever, cough, shortness of breath, or a combination of these symptoms, nonspecific symptoms including fatigue, nausea, and diarrhea may be the initial presenting symptoms of COVID-19 [3]. It has been reported that approximately half of all patients with COVID-19 may initially present with digestive symptoms, although only a small number of patients with proven COVID-19 who have symptoms (3%, as reported in one recent study by Pan et al. [4]) ultimately have only isolated abdominal signs and symptoms. A recent study reporting the chest CT findings of 112 international passengers aboard the *Diamond Princess* cruise ship indicated that 54% of patients without symptoms had lung findings, with CT showing ground-glass opacities in 80% of these patients without symptoms; all individuals in this cohort with suspected or known COVID-19, whether they had symptoms or not, underwent chest CT for screening purposes [5]. Patients with initial primary or

isolated abdominal signs and symptoms who have COVID-19 may present for clinical assessment and imaging even though COVID-19 is not a consideration, although to our knowledge this has not yet been reported. The purpose of the present study was to retrospectively review a series of patients very recently seen in our institutional system who were not initially clinically suspected of having COVID-19, who underwent abdominal and pelvic CT for abdominal signs and symptoms, and who had findings identified at their lung bases that were very concerning for COVID-19. Most of these patients now have proven COVID-19.

Materials and Methods

Patients

A retrospective, institution-wide database search was conducted by an abdominal radiologist to identify reports from abdominal (with a pelvic component) CT examinations of patients who underwent imaging from March 16, 2020, through March 26, 2020, and for whom the terms “COVID” or [“pneumonia/pneumonitis” AND “atypical”] appeared in the report impression. This search identified 23 patients (16 men and seven women; mean [\pm SD] age, 60.7 ± 18.6 years; range, 23–86 years) with unanticipated lung base findings on abdominopelvic CT that were concerning for COVID-19. No patients were excluded from the analysis.

Review of Electronic Medical Records and Radiology Reports

The radiology reports were retrospectively reviewed by an abdominal radiologist with 2 years of postfellowship experience, and clinical indications

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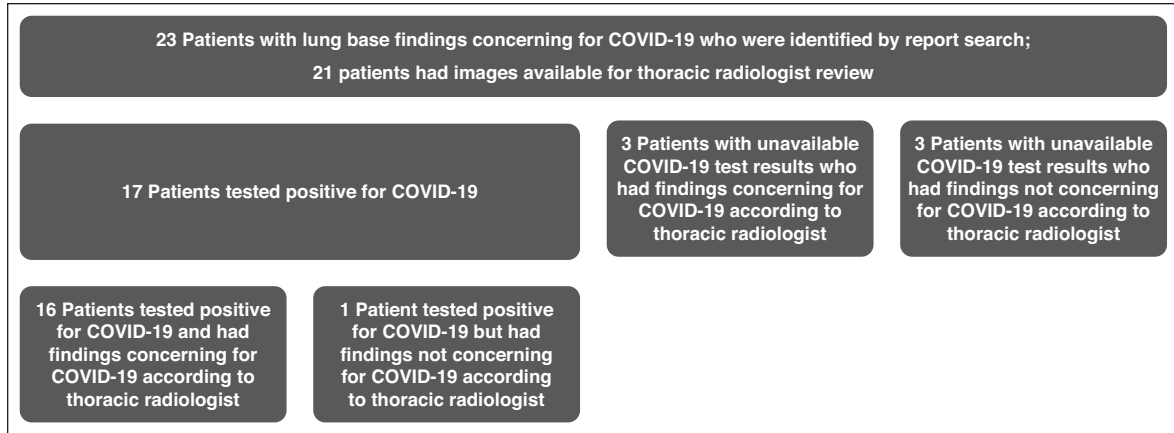


Fig. 1—Flow chart of study patients as categorized by test and imaging findings. COVID-19 = coronavirus disease.

and any additional important findings from the report impressions were recorded. The COVID-19 test results in the electronic medical records of the patients were recorded by the same radiologist to serve as the reference standard, if available.

Concurrently performed chest CT examinations were recorded. Follow-up chest CT or chest radiograph reports, if obtained, were reviewed to confirm lower thoracic findings on abdominopelvic CT.

The electronic medical records were reviewed to determine whether patients ultimately had respiratory symptoms develop and whether they required hospitalization with or without subsequent intubation. The time from onset of symptoms to CT was recorded.

Imaging Review

A thoracic radiologist with 16 years of post-fellowship experience reviewed the lung bases on

all identified abdominopelvic CT images, using our standard clinical PACS (iSite, Philips Healthcare). The pulmonary findings were described according to lobar involvement (with findings considered multilobar if they involved two or more lobes), location (peripheral, central, or subpleural sparing), distribution (peribronchovascular or centrilobular), density (with findings defined as masslike ground-glass opacity [if ≥3 cm], ground-glass nodule [if < 3 cm], solid nodule, consolidation, cavitation, or halo sign), and other findings (interstitial thickening or pleural effusion). The thoracic radiologist also rendered a binary assessment of concern for the presence or absence of COVID-19, on the basis of the appearance of the lung bases on abdominopelvic CT and available clinical information.

Results

Review of Electronic Medical Records and Radiology Reports

All 23 abdominopelvic CT reports raised concern for COVID-19, either directly or on the basis of terminology from a standardized macro in the report impression. Seventeen patients had positive COVID-19 test results. The remaining six patients did not have available COVID-19 test results or additional clinical information, and they underwent secondary review by a thoracic radiologist (Fig. 1).

The reported clinical indications included abdominal pain (n = 19), diarrhea (n = 5), nausea (n = 3), fever (n = 3), and cough (n = 2) (Table 1). The mean time from symptom onset to abdominopelvic CT was 7.1 ± 7.2 days (range, 1–30 days). Eleven patients had no extrapulmonary findings described in the report impression. Other findings detailed in abdominopelvic CT report impressions included urinary calculi (n = 3), pancreatic cancer (n = 2), appendicitis, proctitis, hepatitis, pyelonephritis, unchanged contained leak af-

ter sleeve gastrectomy, unchanged celiac artery dissection, and worsened splenomegaly.

Only two patients underwent concurrently performed chest CT. After abdominopelvic CT was performed, 12 patients underwent follow-up chest radiography, which confirmed the findings described on abdominopelvic CT for 11 patients and further solidified concern for COVID-19. One patient whose chest radiograph was obtained 30 minutes after abdominopelvic CT was performed showed no abnormalities. Another patient underwent follow-up chest CT for the evaluation of pulmonary embolism, which showed segmental pulmonary emboli as well as multilobar peribronchovascular and peripheral ground-glass opacities with subpleural sparing.

Twelve patients were admitted to the hospital, and nine of these patients ultimately had respiratory symptoms develop. The remaining three patients were admitted to the hospital for contained postoperative leak after sleeve gastrectomy, ventriculoperitoneal shunt and percutaneous gastrostomy tube placement, and femur fracture. One patient underwent intubation but then died.

Imaging Review

Twenty-one patients had abdominopelvic CT images available for secondary review by the thoracic radiologist: six images were obtained with IV contrast medium but without oral contrast medium, six were obtained with IV and oral contrast media (four positive and two neutral oral contrast agents), five were obtained without IV or oral contrast medium, and four were acquired with positive oral contrast medium only. Sixteen patients had lung base findings on abdominopelvic CT that were concerning for COVID-19 on the basis of the imaging review of the thoracic radiologist. Two

TABLE 1: Patient Demographic Characteristics and Clinical Indications for Abdominopelvic CT

Characteristic or Indication	Value
Age (y)	
Mean ± SD	60.7 ± 18.6
Range	23–86
Sex	
Male	16
Female	7
Clinical indication for CT	
Abdominal pain	19
Diarrhea	5
Nausea	3
Fever	3
Cough	2

Note—Except where otherwise indicated, data are number of patients.

COVID-19 Findings at the Lung Bases on CT



Fig. 2—33-year-old man who presented with abdominal pain in right lower quadrant, nausea, vomiting, and diarrhea and was found to have multilobar peribronchovascular ground-glass opacities and ground-glass nodules at lung bases on abdominopelvic CT. Axial CT image with lung window shows bilateral asymmetric findings, with more numerous ground-glass nodules and opacities seen in right mid to lower lung compared with left lung. No other findings were identified in abdomen or pelvis. Patient had positive coronavirus disease (COVID-19) test results, after COVID-19 was strongly suggested by interpreting radiologist on basis of abdominopelvic CT.

of the five patients whose images were not concerning for COVID-19 on the basis of the thoracic radiologist's review ultimately had positive COVID-19 test results. For one of these patients, CT findings were a few ground-glass nodules, and for the other patient, CT findings were peribronchovascular ground-glass opacities that were isolated to the middle lobe. Three of the six patients without available COVID-19 test results were deemed to be concerning for COVID-19 by the thoracic radiologist.

For the 17 patients who had positive COVID-19 test results, the most common lung base findings on abdominopelvic CT were ground-glass opacities ($n = 13$), which were most commonly multilobar ($n = 9$), peripheral ($n = 8$), or peribronchovascular ($n = 8$) in distribution. Other patients had consolidation ($n = 4$)

or ground-glass nodules ($n = 3$). No patients had any pleural effusion (Table 2 and Figs. 2–4).

Discussion

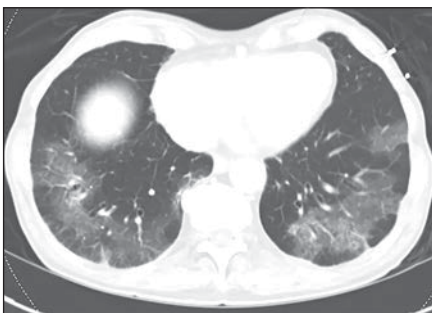
COVID-19 may present with nonspecific gastrointestinal symptoms, most commonly abdominal pain, which may trigger clinicians to obtain abdominopelvic CT without specifically considering COVID-19, even when imaging is performed in an emergency setting in a region affected during the current global pandemic. Ground-glass opacities at the lung bases, which usually are multilobar, peripheral, or peribronchovascular in distribution, are often the only pertinent finding observed on these abdominopelvic CT examinations.

All the patients included in the present study underwent abdominopelvic CT for pri-

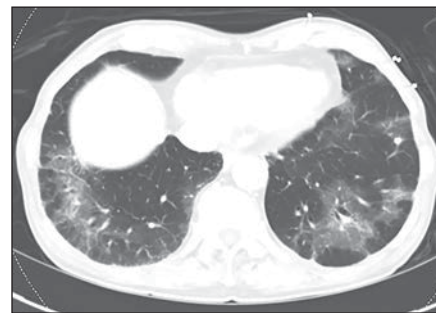
mary abdominal signs, symptoms, or both. Because this subset of patients does not present with respiratory symptoms typical of COVID-19, COVID-19 is often unsuspected by the referring clinician, as was found to be the case in our series on retrospective review of imaging reports and electronic medical records, and by the general public, rendering this an underreported cohort. Similarly, these patients may not be identified by departmental screening measures before CT unless they have a fever (body temperature, $> 38^{\circ}\text{C}$). Consequently, many of these patients may not be subject to departmental or hospital protective measures, including wearing a surgical mask or being placed in patient isolation. This raises substantial concern about the spread of COVID-19 from this patient subset to health care personnel or other patients in the vicinity.

According to the U.S. Centers for Disease Control and Prevention, standard precautions should be followed by health care workers caring for patients with COVID-19 who have no respiratory symptoms. Because it is believed that COVID-19 spreads predominantly via respiratory droplets, the risk to health care personnel from a patient who is not coughing or sneezing likely diminishes after a few minutes [3].

At the time of the writing of this article, in accordance with guidelines provided by the

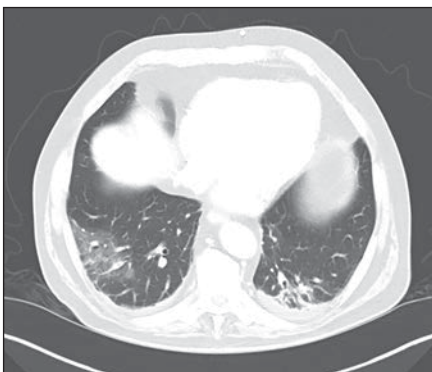


A



B

Fig. 3—84-year-old man with known pancreatic cancer who presented with abdominal pain, nausea, vomiting, diarrhea, and cough. Axial abdominopelvic CT images with lung windows show new bilateral, peripheral, confluent ground-glass opacities in lower lobes with subpleural sparing in lower lungs. Patient was found to have positive coronavirus disease (COVID-19) test results after abdominopelvic CT findings raised concern for COVID-19.



A



B

Fig. 4—81-year-old man who presented with mid abdominal pain. Axial abdominopelvic CT images with lung windows show multilobar peripheral and peribronchovascular ground-glass opacities in lower lungs. No other abdominopelvic findings were identified to explain patient's abdominal pain. Patient had positive coronavirus disease (COVID-19) test results after COVID-19 was suggested by interpreting radiologist on abdominopelvic CT.

TABLE 2: Lung Base CT Findings Based on Review by Thoracic Radiologist

CT Finding	Patients With Images Available for Review (n = 21)	Patients With Positive COVID-19 Test Results (n = 17)	Patients Without COVID-19 Test Results but With Concerning Findings (n = 3) ^a
Lobe			
Multilobar	12	9	3
Lower lobe	4	3	0
Middle lobe	2	1	0
Location			
Peripheral	11	8	3
Central	2	1	1
Subpleural sparing	2	2	0
Distribution			
Peribronchovascular	9	8	1
Centrilobular	1	0	0
Density			
Ground-glass opacity	16	13	1
Ground-glass nodule	6	3	2
Solid nodule	1	1	0
Consolidation	4	4	0
Cavitation	0	0	0
Halo sign	2	2	0
Other			
Interstitial thickening	1	1	0
Pleural effusion	0	0	0

Note—Data are number of patients.

^aImaging findings were concerning for coronavirus disease (COVID-19) as assessed by a thoracic radiologist.

Centers for Disease Control and Prevention and the infection prevention and control team at our institution, our radiologic technologists are wearing gloves and surgical masks. After each patient is examined, the CT scanning table is cleaned thoroughly with disinfecting wipes, which are effective against SARS-CoV-2. The ordering physician is notified by the interpreting radiologist by telephone, also advising patient isolation and COVID-19 testing, if possible.

To our knowledge, lung base findings on initial abdominopelvic CT that are concerning for COVID-19 have not yet been reported for patients with no previous clinical suspicion for COVID-19. Because these patients are almost always without respiratory symptoms, the predominant finding of ground-glass opacities is concordant with recently reported lung findings in patients without symptoms [5]. In our series, these patients presented with abdominal pain, which, as

with other basilar pneumonias caused by multiple organisms and reported in children as well as adults, may be referred pain, especially if located near the pleura or diaphragm. These patients may also have primary abdominal signs and symptoms related to viral infection initially affecting the luminal gastrointestinal tract, although in our limited experience to date, no identifiable gastritis, enteritis, or colitis or other associated findings have been seen in these patients on CT. In addition, the combination of thoracic manifestations and abdominal symptoms is seen relatively commonly in other infections with atypical pneumonia presentations, such as those caused by *Legionella* species, *Mycoplasma* species, and other bacteria and viruses. Although approximately half of all patients in our series underwent follow-up chest radiography, only one patient underwent subsequent chest CT to evaluate for pulmonary embolism, which was present in addition to

findings related to COVID-19, rather than for further evaluation of lung base findings.

The limitations of our series include its retrospective design, small sample size, inability to obtain longer-term follow-up and COVID-19 test results in six patients because of the emergent nature of this report, and the fact that these cases were reported from a single, albeit large regional multicenter institution. However, these cases arose over a very short period. In addition, no pediatric patients were identified. This may reflect general avoidance of the use of CT for the pediatric population and the less common occurrence of clinically manifest COVID-19 in children. However, two radiologists (the interpreting radiologist and a thoracic radiologist) agreed that the lung findings were highly consistent with COVID-19 in nearly all patients, on the basis of the findings reported to date in the literature on the use of dedicated thoracic CT for patients with COVID-19.

Conclusion

In conclusion, unsuspected COVID-19 may be strongly suggested in patients with nonspecific gastrointestinal symptoms on the basis of typical findings at the lung bases on the upper portion of abdominal CT scans. Radiologists identifying such findings should immediately alert the referring clinician of this concern for COVID-19.

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