

Preoperative Computerized Tomography Screening for COVID-19 Pneumonia in Asymptomatic Patients: experiences from two centers

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Abstract

BACKGROUND: Chest CT screening for COVID-19 in preoperative patients is recommended in selected patients. The aim of this retrospective study is to evaluate the preoperative screening performance of chest CT (computerized tomography) examination to detect COVID-19 positive individuals.

STUDY DESIGN: In this retrospective study 218 adult patients who had preoperative chest CT and RT-PCR were enrolled. CT imaging results, which have been reported according to the Radiological Society of North America (RSNA) expert consensus on COVID-19, were collected from the picture archiving and communicating system (PACS). Demographic data, planned surgeries, and postoperative outcomes were collected from the electronic patient records.

RESULTS: One patient (0.5%) showed typical CT features for COVID-19 pneumonia; 12 patients (5.5%) were reported as indeterminate, and eight (3.7%) were reported as atypical for COVID-19 pneumonia. Only one of the three patients with positive RT-PCR had abnormalities on CT. When RT-PCR tests were taken as reference, the sensitivity, specificity, and accuracy of chest CT in showing COVID-19 infection in asymptomatic patients were 33.3%, 90.7%, and 90.0% respectively.

CONCLUSION: Chest CT screening for COVID-19 has a very low yield in asymptomatic preoperative patients and shows false positive findings in 9.2% of cases, potentially leading to unnecessary postponing of the surgery.

Introduction

Since the first case reported in China on December 31, 2019, COVID-19 pandemic has rapidly spread worldwide, resulting in more than 10 million of confirmed cases and half million deaths in less than 6 months [1,2]. Healthcare workers are most vulnerable, comprising in many countries up to 20% of responding health care providers were infected [3]. Although the final diagnosis rests with reverse-transcriptase polymerase chain reaction (RT-PCR), this test has several shortcomings including limited availability, relatively long turnaround times, and a low sensitivity varying between 56-83% [4].

Patients with COVID-19 disease who undergo surgery suffer a complicated postoperative course [5,6]. Studies have shown that up to 51.2% of these patients had pulmonary complications and 51.2% of them died after surgery [7]. Also, these patients increase the risk of disease transmission to other patients in the hospital and health care personnel [8].

Aforementioned diagnostic difficulties associated with the molecular methods coupled with dismal postoperative course and risk of cross-infection to others have led medical care providers to search for complementary diagnostic tools [9,10]. Many studies have demonstrated a higher sensitivity of chest CT for COVID-19 pneumonia than RT-PCR [11-13]. CT was also shown to be positive in a subset of asymptomatic COVID-19 patients [14,15]. Thus, CT has been used in adjunct to molecular methods in

asymptomatic patients scheduled for surgery to screen for COVID-19 disease. In fact, this has also been recommended by well-known radiological societies in selected specific patients before surgery [16].

There is very limited knowledge regarding the use of CT in this peculiar setting. We therefore aimed to evaluate the results of chest CT screening for COVID-19 pneumonia in asymptomatic patients before surgery.

Materials And Methods Patients

The study was a retrospective analysis and approved by the Ethics Committee of Koc University Faculty of Medicine, which waived the requirement for patients' informed consent. Between April 20, 2020 and May 31, 2020 218 adult patients who admitted to two hospitals [one university hospital and one private hospital from the same city) for surgery were enrolled. All patients had undergone a preoperative chest CT and RT-PCR test. Patients who had symptoms suggesting COVID-19 infection were excluded. Patients' demographic characteristics, including the age and gender, and type of surgery were recorded (table 1).

Image acquisition

CT scans were acquired using multidetector CT scanners with 64 [Somatom Definition AS) or 128 (Somatom Definition Flash) detector rows (Siemens Healthineers, Forchheim, Germany) with patients in supine position. The entire chest starting from the lung apices down to posterior costophrenic sulci was scanned with 0.625 mm collimation, 80-120 kVp, and 20-150 mAs. Images were reconstructed with a slice thickness of 1-1.5 mm and an interval of 1 mm. No intravenous contrast medium was administered.

Data Collection

Chest CT images were reported by six radiologists in two centers with 6-20 years of experience in thoracic imaging. All CT reports and CT dose information were retrospectively collected from the picture archive and communication system (PACS). CT findings were classified according to the Radiological Society of North America (RSNA) chest CT classification system for reporting COVID-19 pneumonia as follows: a) CT imaging features typical, b) indeterminate, and c) atypical for COVID-19 pneumonia, and d) No CT features to suggest pneumonia [17].

Typical CT imaging features included peripheral, bilateral ground glass opacities (GGO) with or without consolidation or crazy-paving appearance, multifocal GGO of rounded morphology with or without consolidation or crazy-paving, and reverse halo sign or other findings of organizing pneumonia (Figure 1).

Indeterminate findings included cases who lacked the typical features, but displayed multifocal, diffuse, perihilar, or unilateral GGO with or without consolidation lacking a specific distribution and are non-rounded or non-peripheral. Few very small GGO with a non-rounded and non-peripheral distribution were also regarded indeterminate (Figure 2).

Atypical cases lacked the typical or indeterminate features but had isolated lobar or segmental consolidation without GGO, or discrete small nodules (centrilobular, “tree-in-bud”), lung cavitation, and smooth interlobular septal thickening with pleural effusion (Figure 3).

Additionally reports were searched for incidental malignant findings.

Statistical analysis

Statistical analyses were performed using SPSS software (version 24.0, IBM). Measurement data are were expressed as mean \pm standard deviation, and categorical variables were reported as counts and percentages.

Results

Demographic characteristics and general information

218 patients [107 patients from the university hospital and 111 patients from the private hospital) were enrolled in this study (114 male, 104 female, mean age 56 ± 15.6 years (range, 24-91 years)). Mean DLP value for university hospital was 200.14 mGy \times cm and for private hospital was 214.07 mGy \times cm.

Of the whole study group, 197 patients (90.4%) had no CT findings suggesting pneumonia. One patient (0.5%) showed typical CT features for COVID-19 pneumonia; 12 patients (5.5%) were reported as indeterminate, and eight (3.7%) were reported as atypical for COVID-19 pneumonia. None of the patients had incidentally discovered thoracic malignancies or newly discovered metastasis.

Of 218 patients, three (1.4%) had positive and 215 (98.6%) had negative RT-PCR test result. Only one of the three patients with positive RT-PCR had findings on chest CT that may be attributed to pneumonia. Of 215 patients with negative RT-PCR result, 20 (9.3%) had CT abnormalities attributable to pneumonia. 12 of this 20 patients had indeterminate CT findings and eight had atypical CT findings for COVID-19.

Performance of chest CT-screening in diagnosing COVID-19 in asymptomatic patients

In 21 patients COVID-19 pneumonia could not be ruled out based on chest CT findings. Only one of these had typical CT findings for COVID 19 pneumonia whereas the rest had indeterminate or atypical CT findings. When RT-PCR tests were taken as reference, the sensitivity, specificity, and accuracy of chest CT in showing COVID-19 disease were 33.3%, 90.7%, and 90.0%, respectively. The positive and negative predictive values were 4.8% and 99.0%, respectively.

Two patients with positive RT-PCR results had no lesions suggesting COVID-19 pneumonia on chest CT. All 12 patients with indeterminate CT findings and all eight patients with atypical CT findings for COVID-19 were RT-PCR negative. Of the 20 patients with indeterminate or atypical findings, 16 (80%) had unilateral lung lesions, 12 (60%) had unilateral ground-glass opacities, two (10%) had

segmental/subsegmental consolidation, 4 (20%) had unilateral discrete small nodules, and two (10%) had smooth interlobular septal thickening.

72 (33.0%) patients needed emergent and 146 (67.0%) patients needed elective surgery. All but three patients who needed emergent surgery had negative chest CT and RT-PCR results. Three patients had indeterminate CT findings and were operated without delay with relevant precautions for airborne infection. RT-PCR tests repeated after surgery in these three patients were also normal.

Out of the 146 patients who needed elective surgery, 126 had negative CT and PCR results and underwent surgery timely. Nine patients with indeterminate CT and eight patients with atypical CT findings had negative PCR results. 15 of these patients were operated without a delay. In the remaining two patients, both of whom had atypical CT findings, surgery was delayed for two and three days, after a repeat RT-PCR was negative.

One patient who had typical CT findings and a positive RT-PCR test was operated after 24 days of treatment with Plaquenil (Fig. 2).

None of the 21 patients with positive chest CT findings suffered from postoperative complications and were discharged with a mean hospital stay of 5.1 days. Age, gender, planned surgery, CT features and surgical outcome of CT and/or RT-PCR positive patients were summarized in table 2.

Two patients had negative CT findings but positive PCR results. One of the patients had elective endoscopy and the other lumbar discectomy. Both of the interventions were canceled till a negative PCR result is obtained. Both patients were under surveillance without medication administration.

Discussion

In this study we investigated the performance of chest CT as a screening method for COVID-19 in asymptomatic surgery patients. In our study CT was true positive in one patient, whereas it was false positive in 20 patients and 10% of these patients encountered an unnecessarily delay for surgery. All patients who faced with a delay were candidates for elective surgeries, none of the emergency cohort requiring surgery encountered a delay. None of these 20 patients experienced an unexpected poor postoperative course. These findings support the previously reported low specificity of chest CT for COVID-19 pneumonia [18].

On the other hand in our study CT showed features of pneumonia in only one of three asymptomatic COVID-19 positive patients. The positivity rate is lower than reported on an earlier study, in which CT was positive in 79% of asymptomatic test-positive patients [19]. However, that study was performed on passengers in a cruise ship under quarantine, who had a longer close contact with COVID-19 patients.

An important finding of our study is that CT shows findings attributable to pneumonia in 9.6% of asymptomatic preoperative patients. Furthermore these findings were typical or indeterminate for COVID-19 pneumonia in 5.9% of patients. Our findings are similar to those of Chetan et al, who reported that 3%

of preoperative patients had classic/probable and 4% had indeterminate findings for COVID-19 pneumonia [20].

Limitations of our study involve its retrospective design with a heterogeneous preoperative patient group including candidates for emergency and elective surgery.

This retrospective study showed that CT screening in asymptomatic cases is not adequately sensitive in detecting RT-PCR positive COVID-19 patients. Moreover, an important minority of patients may show false positive findings, which may potentially mislead patient management, including unnecessary postponing of the interventions. Besides potential harms of radiation must be kept in mind while considering chest CT as a screening method. Preoperative CT screening should not be ordered on a routine basis in asymptomatic patients, especially when rapid RT-PCR tests are available.

Declarations

Conflict of Interest:

The Author(s) declare(s) that there is no conflict of interest.

Competing Interest:

The authors declare no competing interests

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Tables

Table 1. Distribution of patients on the basis of intervention

Intervention	Patients (n=218)
General surgery	59 (27.0%)
Neurosurgery	38 (17.4%)
Orthopedics and traumatology	27 (12.3%)
Obstetrics and gynecology	19 (8.7%)
Urosurgery	17 (7.8%)
Thoracic surgery	15 (6.9%)
Cardiovascular surgery	7 (3.2%)
Ear nose and throat surgery	7 (3.2%)
Plastic and reconstructive surgery	4 (1.8%)
Ophthalmology	2 (0.9%)
Interventional procedures (gastrointestinal endoscopy, bronchoscopy, cardiac catheterization)	23 (10.6%)

Table 2.

Age [years)	Gender	Planned surgery	CT feature	RT-PCR	Surgical outcome
34	f	Stereotactic Brain Biopsy	Atypical for COVID-19	Negative	After 2 days delay and achieving negative RT-PCR result, operated and discharged after 5 days without complication.
37	f	A Loop Electrosurgical Excision Procedure (LEEP) of uterine cervix	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 1 day without complication.
39	m	ureter stone removal	Atypical for COVID-19	Negative	No postpone. Patient discharged same day without complication
40	m	radical resection for ampullary cancer	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 11 days without complication. A control CT obtained 25 days after initial CT showed the disappearance of lesions.
44	m	Lumbar discectomy	Atypical for COVID-19	Negative	No postpone. Patient discharged after 3 days without complication.
53	m	Lobectomy	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 4 days without complication.
52	f	Craniotomy for subdural hematoma	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 10 days without complication.
53	m	Meniscectomy	Indeterminate for COVID-19	Negative	No postpone. Patient discharged same day without complication
83	m	Hydrocelectomy	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 1 day without complication.
65	f	Lobectomy	Atypical for COVID-19	Negative	No postpone. Patient discharged after 4 days without complication.
55	m	Pancreatectomy	Atypical for COVID-19	Negative	No postpone. Patient discharged after 11 days without complication.
59	f	Cranial flap replacement	Indeterminate for COVID-19	Negative	After 2 days delay and achieving negative RT-PCR result, operated and discharged after 7 days without complication.
65	m	<i>Transmetatarsal amputation</i>	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 8 days without complication.
71	f	Hemicolectomy	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 10 days without complication
66	m	Ureteral dilatation and stenting	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 2 days without complication
60	f	Arthroscopic shoulder surgery	Atypical for COVID-19	Negative	No postpone. Patient discharged same day without complication
64	m	Cholecystectomy	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 3 days without complication
76	f	Hemicolectomy	Atypical for COVID-19	Negative	No postpone. Patient discharged after 11 days without complication
81	f	Total hip arthroplasty	Atypical for COVID-19	Negative	No postpone. Patient discharged after 11 days without complication
57	m	Coronary angioplasty & stent procedure	Indeterminate for COVID-19	Negative	No postpone. Patient discharged after 1 day without complication
35	m	Distal pancreatectomy & splenectomy	Typical for COVID-19	Positive	After 24 days delay, treatment with Plaquenil and achieving negative RT-PCR result, operated and discharged after 12 days without complication.
75	m	Upper gastrointestinal track endoscopy	No finding suggesting pneumonia	Positive	Endoscopy procedure canceled.
64	m	Lumbar discectomy	No finding suggesting	Positive	Surgery suspended. After a negative RT-PCR, surgery will be rescheduled.

Figures

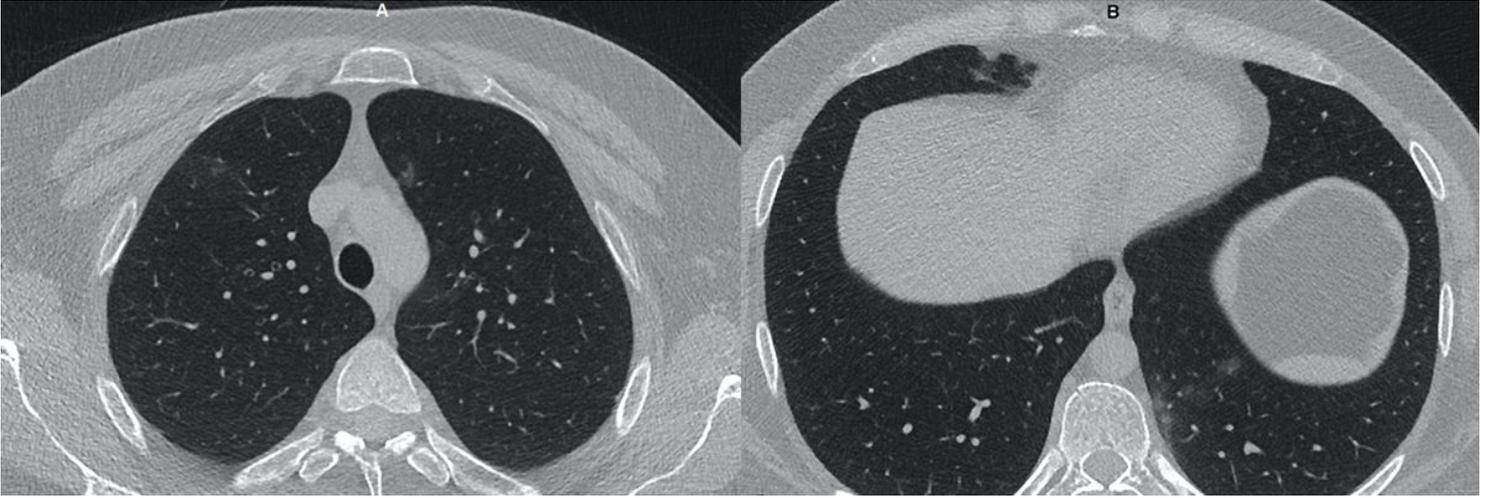


Figure 1

A, B An example for a patient reported as typical pattern for COVID-19. Axial chest CT showing (A) bilateral GGO in upper lobes and (B) in left lower lobe.

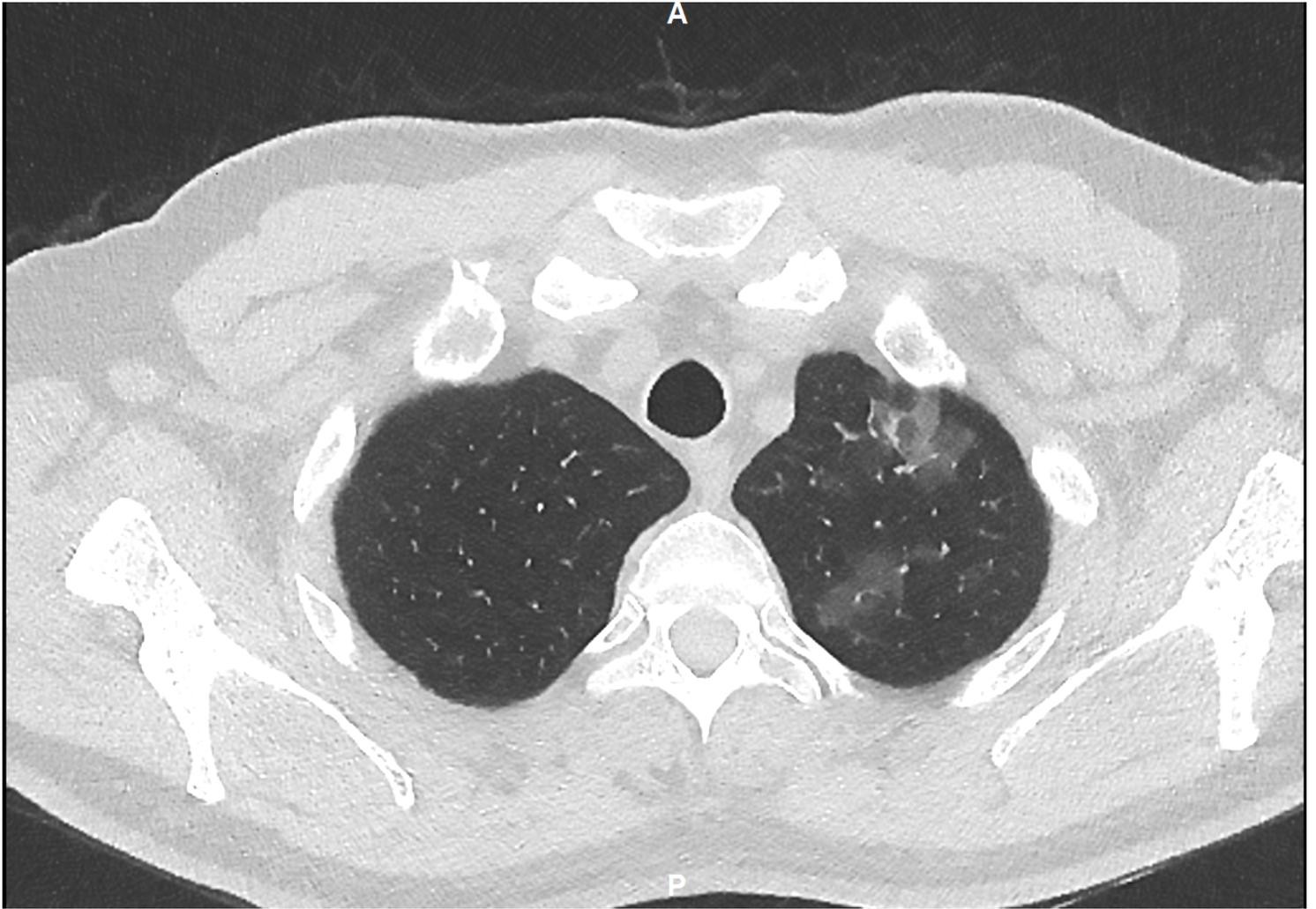


Figure 2

An example for a patient reported as indeterminate pattern for COVID-19. Axial chest CT showing focal GGO confined to left upper lobe.



Figure 3

An example for a patient reported as atypical pattern for COVID-19. Axial chest CT showing discrete centrilobular small nodules in left lower lobe. Other lung lobes were normal.