

Asymptomatic COVID-19 infection in multiple trauma patients: should we obtain more CT-scans?

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Research article

Keywords: COVID-19, SARS-CoV-2, fractures, multiple trauma, trauma center

Posted Date: August 3rd, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-51098/v1>

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Abstract

Background: There are studies that show a chest CT scan is superior to reverse transcription-polymerase chain reaction (RT-PCR) studies in the diagnosis of COVID. This study was designed to assess the prevalence of COVID-related lung involvement in patients admitted to a trauma center.

Methods: In a retrospective study, data from a regional referral trauma center from February 21, 2020 to April 10, 2020, were reviewed. All patients admitted to the hospital for whom a chest CT scan was performed during the study period for any reason were included. Trained physicians screened all CT-scans for findings suggestive of COVID-19. Next, blinded radiologists selected CT-scans with findings highly suggestive of COVID involvement. The clinical course and outcome, and the results of PCR for SARS-CoV-2 were recorded assessed.

Results: A total of 4200 chest CT scans were reviewed. After multiple rounds of exclusion, 24 patients with highly- suggestive findings were reviewed. Only three patients developed COVID symptoms during the course of admission. PCR results were positive in 22 patients (92.6%).

Conclusions: We suggest having a lower threshold for ordering chest CT scans in trauma patients at a high risk of COVID infection, as well as those requiring extensive surgical interventions. Also, a thorough review of the available CT scans before invasive procedures, preferably with the help of an expert radiologist, is highly recommended, even when the results of the COVID laboratory tests are negative.

Background

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that causes the Coronavirus disease 2019 (COVID-19), first emerged in China at the end of 2019 and soon spread throughout the world [1]. Presentation of SARS-CoV-2 infection ranges from asymptomatic infection to mild pneumonia and severe disease with dyspnea to critical disease with respiratory failure, shock, or multiorgan dysfunction. [2]

As cases of COVID-19 increase globally, the knowledge around this virus is evolving. But so far, there are no reliable treatments on the close horizon to manage COVID-19 or a vaccine to prevent its spread. Also, clinicians face a significant challenge in dealing with complications related to this infection. Therefore, social distancing has been adopted globally to 'flatten the curve' of COVID infection. Iran was hit hard with an early outbreak and a high initial rate of infection. Following the national lockdown orders, the rate of infection has reduced substantially, which has also led caused economic collateral damage. Countries around the world have already started to loosen the social distancing rules, which may lead to the spread of infection [3].

Trauma centers have a unique role in the healthcare system. The economic restart will increase the patient load of trauma centers. Combined with the anticipated increase in the incidence of COVID-19,

trauma centers might be on the brink of an unanticipated resurgence of COVID, which they are unlikely to be prepared for.

Chest CT scan is highly sensitive and specific in the diagnosis of COVID, even in asymptomatic cases. There are studies that show a chest CT scan is superior to reverse transcription-polymerase chain reaction (RT-PCR) studies in the diagnosis of COVID, with the added advantage of being able to follow the progression of the disease objectively [4, 5].

This study was, therefore, designed to assess the prevalence of COVID-related lung involvement in patients admitted to a trauma center. We hypothesized that considering the high prevalence of asymptomatic COVID infections reported previously, we would encounter a high incidence of COVID-related chest CT scan changes in asymptomatic patients.

Methods

In a retrospective study, data from a regional referral trauma center from February 21, 2020 to April 10, 2020, were reviewed. Inclusion criteria included patients admitted to the hospital, for whom a chest CT scan was performed during the study period for any reason. While admissions for all reasons were included, only multiple trauma patients are routinely evaluated with a chest CT scan, and therefore, there is a high probability of having orthopaedic injuries. Patients who were re-admitted and those with incomplete records were excluded. Also, for patients with >1 CT scans, only the first imaging after admission was reviewed. All data were accessed through the electronic health system, and CT scans were reviewed on the computer screen from the picture archiving and communicating system (PACS).

A physician was trained to screen all CT scans, looking for COVID-related findings, which were extrapolated from the literature [6-8]. This investigator was unaware of the clinical condition of the patients, as well as the status of COVID infection. A form was filled for each CT scan (Appendix 1), and the presence of ≥ 1 findings suggestive of COVID qualified the patient for the next round of readings.

Next, two experienced radiologists, also unaware of the clinical course and diagnosis of the patients, separately examined the CT scans from the previous round. In compliance with the national guidelines, the Iranian radiology society criteria for reporting COVID imaging were used, which reports CT scans in three categories [4]: highly-suggestive, inconsistent, and normal. A separate form was used by the radiologists to report their findings (Appendix 2), with details of the lobes involved and the patterns visible on CT scans.

The charts of the patients remaining after the second round of screening were extracted and thoroughly reviewed. Demographic data, presence or absence of clinical COVID symptoms, the results of deep nasal swab polymerase chain reaction (PCR) for SARS-CoV-2, and the reason for admission, as well as the clinical course and outcome, were recorded.

Descriptive statistics were used to report frequencies and means. All statistical analyses were performed using the IBM SPSS Statistics for Windows, Version 23.0 (Armonk, NY, IBM Corp).

Table 1. Iranian radiology society preferred reporting of COVID imaging studies.

Highly-suggestive findings
Ground glass/consolidation opacities
Bilateral/multilobe involvement
Peripheral distribution
Round opacities
Inconsistent findings
Tree in bud opacities
Centrilobular distribution
Peri-Broncho-vascular disruption
Predominantly nodular opacities
Cavitation
Lymphadenopathy
Pleural effusion

Adapted from Radiologic management of COVID-19: preliminary experience of the Iranian Society of Radiology COVID-19 Consultant Group (ISRCC). Iranian Journal of Radiology, 2020.

Results

During the study period, 4200 patients underwent a chest CT scan at our institution. After the first round of readings, 320 studies (7.6%) were selected as having findings suggestive of COVID. After separate readings by two radiologists, 74 CT scans were selected. Next, patients having patterns with the highest specificity for COVID were selected by consensus between the two radiologists. The last round yielded 24 records (Figure 1).

Of the 24 patients, 20 (83%) were male. The mean age was 37.6 years (SD 3.5). Sixteen patients were admitted following a car accident, five after a falling accident, and three with blunt trauma from fights. Sixteen patients (67%) had sustained a fracture or dislocation (Appendix 3). Three patients (12.5%) had respiratory symptoms compatible with COVID. The mean white blood cell count of the patients was 14,500 (range, 4,900-23,900, SD:4,542.23) with a lymphocyte count of 2500.

One of the patients developed ARDS during the hospital stay and died following admission to the ICU. The remaining 23 patients were discharged following recovery from their initial injuries. All patients who came to the hospital due to trauma and required treatment underwent surgery and were discharged after the operation with no early complications.

On the chest CT scans, all 24 patients had a rounded morphology pattern of ground-glass opacities, and 4 patients also had the crazy-paving pattern. The lobes involved were left upper and lower lobes (each in 15 patients), right lower lobe (15 patients), right upper lobe (14 patients), and right middle lobe (9 patients). Eight patients had universal involvement of all lobes (33%). Five patients had unilateral involvement (3 on the right, 2 on the left).

The results of PCR for SARS-CoV-2 were positive in 22 patients. When highly-suggestive CT-scan findings were considered the diagnostic gold-standard, a positive PCR had a sensitivity of 92.6%. Both patients with a negative PCR result were asymptomatic and had limited lobar involvement.

Discussion

Several countries have already started to ease the social distancing interim laws. The re-opening of the economy will nevertheless result in the resurgence of COVID [9]. With neither a proven treatment nor a vaccine available, this may result in overloaded hospitals in a yet recuperating healthcare system. Trauma centers will be at the forefront of this crisis, as the trauma caseload will undoubtedly increase, and COVID might affect the treatment and prognosis of traumatic injuries drastically [10]. In this study, we retrospectively reviewed the available CT scans of patients admitted in a 45-day period, to determine the prevalence of highly-suggestive findings of lung involvement due to COVID. Our findings are alarming, as we found 24 patients with lung involvement, most of which were multi-lobar. Only three patients were symptomatic on further review of the charts.

CT Scan has been shown to be highly specific in the diagnosis of COVID [4, 5]. We found ground-glass opacities of round morphology to be the most common findings, similar to previous studies [11]. Some studies have shown that the sensitivity and specificity of CT findings are higher than those of PCR studies [5]. In this study, PCR had a sensitivity of 92.6% in patients with highly-suggestive CT findings. It should be noted that due to the overload of the laboratory facilities at our institution at the beginning of the pandemic, the results of the PCR tests were reported at least 1.5 days after the request, and were not available if the patients required an emergent surgical intervention.

A high rate of asymptomatic infection has been reported with COVID, and some studies have suggested that early screening of highly-suspected cases with CT scans may predict severe complications such as acute respiratory distress syndrome (ARDS)[12]. At a minimum, isolation measures could be undertaken earlier, contact tracing be commenced in regions with such measures, and PCR studies rechecked if negative[13]. With the high infectivity rate of COVID, these steps are necessary to break the chain of infection.

Patients in trauma centers are likely to require surgical intervention during their hospital stay. Surgery in patients with COVID has been shown to have a high complication rate, including ARDS, long ICU stay, and a high rate of postoperative mortality [14]. A proportion of surgical interventions could be postponed with no to minimal change in prognosis, including some orthopedic and reconstructive procedures. Therefore, during the current pandemic, proper screening and diagnosis of high-risk patients are absolutely essential to reduce mortality and improve prognosis.

This study has several limitations, including those inherent to a retrospective chart review. We did assess the results of COVID PCR or antibody tests for the intermediately suggestive findings due to a high rate of inconclusive tests at the beginning of the study period. Also, some patients might have become symptomatic after discharge. We also did not include the less-suggestive finding to increase the specificity of our imaging findings.

Conclusions

In conclusion, in a retrospective review of 4200 chest CT scans of patients at a trauma center, we found 24 patients with highly-suggestive findings of COVID, with all except three being asymptomatic. The sensitivity of PCR was 92% in the presence of highly-suggestive CT findings. We suggest having a lower threshold for ordering chest CT scans in trauma patients at a high risk of COVID infection, as well as those requiring extensive surgical interventions. Also, a thorough review of the available CT scans before invasive procedures, preferably with the help of an expert radiologist, is highly recommended, even when the results of the COVID laboratory tests are negative.

Abbreviations

CT: computed tomography

COVID-19: Coronavirus disease 2019

RT-PCR: Reverse transcription polymerase chain reaction

SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2

PACS: Picture archiving and communication system

ARDS: acute respiratory distress syndrome

ICU: intensive care unit

Declarations

Ethics approval and consent to participate:

Ethical approval was obtained by the ethics committee of the Kermanshah University of Medical Sciences. All consents to participate were obtained from the participants.

Consent for publication:

Written patient consent was obtained for publication of all aspects of the case, including personal and clinical details and images from the patient.

Availability of data and materials:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

Funding:

No funding was received for this study.

Authors' contributions:

SSK, FN, RM, MSM, MK, and SM contributed to the conception of the work, data collection, and reporting the radiographs. SSK, FN, MK, and SM contributed to the statistical analysis. SSK, RM, MG, and AB contributed to writing the first draft of the manuscript and the revisions. SSK, FN, RM, MSM, MK, SM, MG, and SB have read and approved the final version of the manuscript and take full responsibility for the accuracy and integrity of the work.

Acknowledgements:

The authors would like to thank Javad Veisi, M.D, Mehdi Naderi, Ph.D., from the Clinical Research Development Center, for their cooperation and assistance throughout the study.

References

1. Wang C, Horby PW, Hayden FG, Gao GF: **A novel coronavirus outbreak of global health concern.** *The Lancet* 2020, **395**(10223):470-473.
2. Guan W-j, Ni Z-y, Hu Y, Liang W-h, Ou C-q, He J-x, Liu L, Shan H, Lei C-l, Hui DS: **Clinical characteristics of coronavirus disease 2019 in China.** *New England journal of medicine* 2020, **382**(18):1708-1720.
3. Wilder-Smith A, Freedman DO: **Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak.** *Journal of Travel Medicine* 2020, **27**(2).

4. Mahdavi A, Khalili N, Davarpanah AH, Faghihi T, Mahdavi A, Haseli S, Sabri A, Kahkouee S, Kazemi MA, Mehrian P: **Radiologic management of COVID-19: preliminary experience of the Iranian Society of Radiology COVID-19 Consultant Group (ISRCC).** *Iranian Journal of Radiology* 2020(In Press).
5. Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, Tao Q, Sun Z, Xia L: **Correlation of chest CT and RT-PCR testing in coronavirus disease 2019 (COVID-19) in China: a report of 1014 cases.** *Radiology* 2020:200642.
6. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, Diao K, Lin B, Zhu X, Li K: **Chest CT findings in coronavirus disease-19 (COVID-19): relationship to duration of infection.** *Radiology* 2020:200463.
7. Shi H, Han X, Jiang N, Cao Y, Alwalid O, Gu J, Fan Y, Zheng C: **Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study.** *The Lancet Infectious Diseases* 2020.
8. Salehi S, Abedi A, Balakrishnan S, Gholamrezanezhad A: **Coronavirus disease 2019 (COVID-19): a systematic review of imaging findings in 919 patients.** *American Journal of Roentgenology* 2020:1-7.
9. Di Domenico L, Pullano G, Sabbatini CE, Boëlle P-Y, Colizza V: **Expected impact of reopening schools after lockdown on COVID-19 epidemic in Île-de-France.** *medRxiv* 2020:2020.2005.2008.20095521.
10. Mi B, Chen L, Xiong Y, Xue H, Zhou W, Liu G: **Characteristics and early prognosis of COVID-19 infection in fracture patients.** *The Journal of bone and joint surgery American volume* 2020, **102(9):750.**
11. Ye Z, Zhang Y, Wang Y, Huang Z, Song B: **Chest CT manifestations of new coronavirus disease 2019 (COVID-19): a pictorial review.** *European radiology* 2020:1-9.
12. Wynants L, Van Calster B, Bonten MM, Collins GS, Debray TP, De Vos M, Haller MC, Heinze G, Moons KG, Riley RD: **Prediction models for diagnosis and prognosis of covid-19 infection: systematic review and critical appraisal.** *bmj* 2020, **369.**
13. Lam RPK, Hung KKC, Lau EHY, Lui CT, Chan KL, San Leung C, Wong IW, Wong KW, Graham CA, Woo PCY: **Clinical, Laboratory, and Radiological Features Indicative of Novel Coronavirus Disease (COVID-19) in Emergency Departments—A Multicentre Case-Control Study in Hong Kong.** 2020.
14. Lei S, Jiang F, Su W, Chen C, Chen J, Mei W, Zhan L-Y, Jia Y, Zhang L, Liu D: **Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection.** *EClinicalMedicine* 2020:100331.

Figures

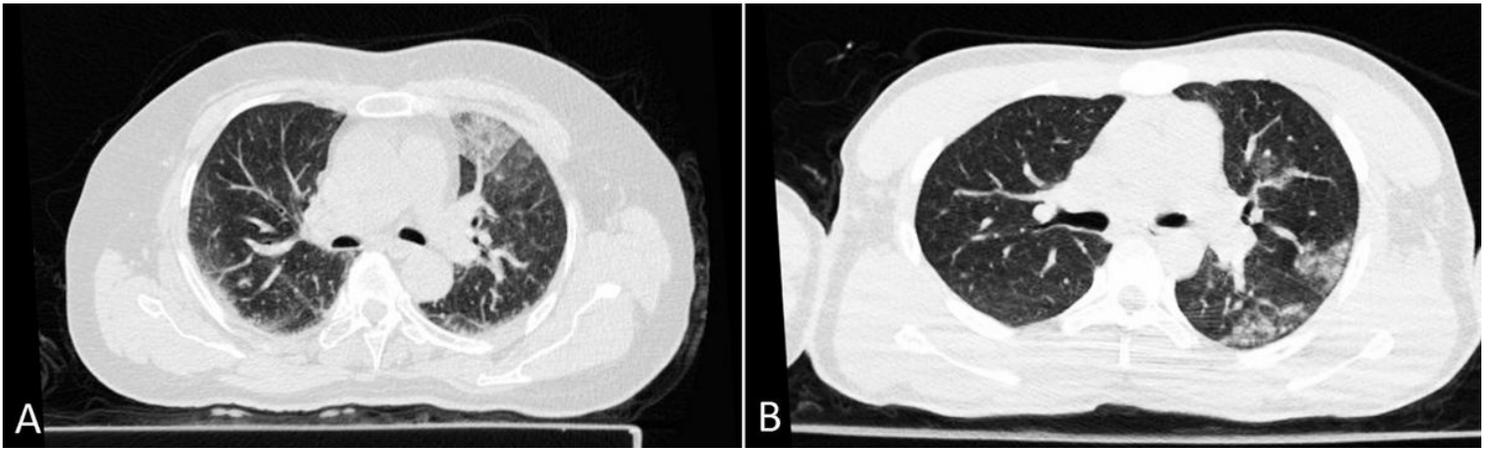


Figure 1

Asymptomatic COVID-19 infection in a multiple trauma patients. A 51-year-old patient with a both-bone forearm and proximal humeral fractures following a car accident. The patient had no respiratory symptoms, despite diffuse involvement of both lungs, as evident on the CT scan (A). Chest CT scan of an 18-year-old male admitted following a fall from a height, with bilateral calcaneal and lumbar spine fractures. The patient was also asymptomatic (B).