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Original Article

# Comparison of CT scan findings of COVID-19 Pneumonia in patients with and without cancer

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**Abstract**

**Introduction:** COVID-19 pneumonia is one of the critical health system challenges in the world. This study aimed to compare the imaging and staging findings of the COVID-19 pneumonia CT scan in patients with and without cancer.

**Methods**: In this case-control study, 109 cancer patients as the case group and 214 non-cancer patients as the control group were included. Covid-19 patients with and without cancer referred to Amir Al-Momenin, and Khansari Hospital in Arak city from June 2020 to July 2021 were included. The data were organized into demographics, underlying medical conditions, ICU admission, and imaging findings.

**Results:** Overall, 323 Covid-19 patients were included in the analysis, and 109 cases of them were cancer patients. The mean age was 63.12±15.38 years, and 53.87% were female. Intensive Care Unit (ICU) admission rate (41.28% vs 41.28%12.62%) was significantly higher in the cancer group than in the control group (P<0.001). The involvement of lung lobes in the cancer group was higher than in the control group (P=0.011) (70.56% in the left lung and 71.1% in the right lung of cancer patients than 77.40% in the left lung and 83.10% in the right lung). The presence of Ground Glass Opacities (GGO) was higher in CT images of the cancer group in all lobs. This difference in the right upper lobe (RUL) lob was significant (P=0.011) and consolidation (CON) was higher in CT images of the control group, but the differences were not significant (P>0.05). The mean total score in the cancer group was 6.23±2.76 and in the control group was 5.87±2.23 (P=0.202). The mean score in the cancer group of left lower lobe (LLL) lung lobes was 1.46±0.94 and in the control group was 1.21±0.76 (P=0.010) (Table 2).

**Conclusion:** The results showed that GGO and consolidation were common findings in CT images. GGO was higher in cancer patients. The involvement of lung lobes in the cancer group was higher than in the control group. ICU admission rate was significantly higher in cancer patients.

**Keywords:** CT scan, COVID-19, Cancer.

## Introduction

COVID-19 pneumonia is one of the critical health system challenges in the world [1,2]. One of the essential issues related to COVID-19 is the diagnosis of patients in the community [3-5]. Early methods for diagnosing COVID-19 pneumonia include the RT-PCR and CT SCAN of the chest. Imaging plays a crucial role in the diagnosis of the COVID-19 disease [6].

According to previous studies on pandemic infections, patients with active or inactive cancers are at high-risk for viral infections such as influenza A, H1N1, SARS-Cov, MERS-Cov, and Ebola. These infections change immune responses that have been associated with a worse prognosis [7-10]. Compared to general populations, COVID-19 is more dangerous and deadly for elderly patients and those with underlying physical diseases [11-14]. Cancer patients are sensitive to Covid-19 due to their systemic immunosuppressive state caused by cancer and related therapies, such as chemotherapy

and/or radiation treatment [15].

Recent studies have shown that patients with cancer are more likely to develop COVID-19 infection than healthy individuals following an immune deficiency. Preliminary studies on COVID-19 in patients with cancer over 30 days showed that 13% of patients with active cancer or a history of COVID-19 were diagnosed. Also, factors such as male gender, age, history of smoking, and the number of underlying diseases are among the factors that play a significant role in increasing mortality in these patients [10-15].

Considering the importance of preventing and controlling COVID-19 infection in patients with immunodeficiency, including cancer, also considering the epidemic of this virus in different provinces and the limited information available in the field of patients with cancer and the importance of CT scan in Diagnosis and severity of pulmonary involvement in patients with Covid-19. This study aimed to compare the imaging and staging findings of the Covid-19 pneumonia CT scan in patients with and without cancer.

## Methods

### Study design

Overall, 109 cancer patients in the case group and 214 non-cancer patients in the control group were included in this case-control study. The age was matched between two groups. The proposal of this study was confirmed by the Research Ethics Committee of Arak University of Medical Sciences. Covid-19 patients with and without cancer referred to Amir Al-Momenin, and Khansari Hospital in Arak city from June 2020 to July 2021 were included.

### Exclusion criteria

Patients with primary or metastatic lung cancer, having a history of chemotherapy and radiotherapy six months before, smoking and drug addiction, and pregnancy positive were excluded.

### Sampling

Jianbo Tian et al. [16] estimated the frequency of ground-glass opacity in patients with and without cancer to be 76% and 61%, respectively, and considering alpha equal to 5%, power 80%, and the case to control the ratio of 1 to 2. The required sample size for the case group was 110 people and for the control group was 220 people, a total of 330 people were included in the study.

### Variables

Demographic information including age, sex, and history of the underlying disease was recorded in the prepared checklist through face-to-face interviews. The incidence of cancer was based on the confirmation of the malignancy as well as the laboratory and pathological documentation of the patients. Pulmonary cancer cases or patients with pulmonary metastasis were excluded.

To evaluate for COVID-19, patients underwent a visit to an infectious disease specialist, and a PCR test was performed to confirm the diagnosis. Only routine tests were performed on the patient.

A CT scan was performed using 16 slices, without contrast, whereas the patient was in the supine position and at the end of their tail. The cut thickness of all CT scan images was 0.5-5 mm. The scans were examined for the 1. Ground Glass Opacities, 2. Consolidation, 3. Mixed Ground Glass with Consolidation Opacities, 4. Crazy Paving Appearance, 5. Halo sign, 6. Reverse Halo sign, 7. Pulmonary Nodules with a halo, 8. Tree in the bud, 9. Centrilobular Nodules, 10. Bronchial wall thickening, 11. Traction bronchiectasis, 12. Normal.

Pulmonary involvement score (CT score) after evaluating all five lobes, separately, was as follows: Score zero: no involvement, score 1: mild involvement of one lobe, score 2: mild involvement of one lobe, score 3: moderate involvement of one Lobe, Score 4: Severe involvement of a lobe. The sum of the scores of pulmonary involvement in each patient is determined by summing the scores of 5 lobes. The CT scan conflict score reaches its peak on the 6th to the 10th day of infection. So, the CT score was determined for the patients on the sixth to the tenth day.

The results of the initial CT scan After confirmation of the disease, patients in both groups were

evaluated by the principal facilitator (radiologist) based on the mentioned patterns. Then, in addition to the type of involvement pattern, a pulmonary involvement score was recorded for each patient.

Ct-score grading was assessed according 0=none, 1=<20%, 2=25-50% mild, 3=50-75% sever and 4=75-100 complete in this study.

## Statistical analysis

Data were analyzed via SPSS-20 software. After entering the information in Stata software, central indicators, dispersion, and graphs were used to examine descriptive statistics. Kolmogorov Smirnov test was used for assessing normality test. Chi-square and Independent Sample T-test were used at a significance level of less than 0.05 to compare the two groups.

## Results

Overall, 323 Covid-19 patients were included, and 109 cases of them were cancer patients. The mean age was 63.12±15.38 years, and 53.87% were female. There were no differences between the two groups regarding the distribution of age and sex (P=0.56 and 0.38, respectively) (Table 1).

Table 1: Distribution of age, sex, ICU admission, in the two groups

| Items | | Control | Cancer | P-value |
|---|---|---|---|---|
| Age, years | | 63.41±14.43 | 63.12±15.38 | 0.56 |
| Sex | Female | 119 (55.61%) | 55 (50.46%) | 0.38 |
| | Male | 95 (44.39%) | 54 (49.54%) | |

In the cancer group, 45 (41.28%) cases and the control group 27 (12.62%) cases were admitted to the ICU. ICU admission rate was significantly higher in the cancer group than in the control group (P<0.001) (Table 2).

## Lobe distributions

The lobes of the left and right lung were equally affected by Covid-19 in both control and cancer patients; 70.56% in the left lung and 71.1% in the right lung of cancer patients in comparison with 77.40% and 83.10% in left and right lungs of the control group, respectively. Also, the involvement of lung lobes in the cancer group was higher than in the control group (P=0.011). The right upper lobe (RUL) and left lower lobe (LLL) were the most and the least involved lobes in the cancer group compared to the control group, respectively. The RLL and right upper lobe (RUL) were the most commonly involved lobes in the control group; 71.1% and 71.0%, respectively.

## Patterns of the lesions

The results showed that GGO and consolidation were common findings in CT images all Lobs (Table 2). The presence of GGO was higher in CT images of the cancer group in all lobs. This difference in the right upper lobe (RUL) lob was significant (P=0.011), and consolidation (CON) was higher in CT images of the control group, but differences were not significant (P>0.05) (Table 2). Also, the incidence of Crazy showed a significantly higher rate in cancer patients in RUL and RML lung lobes (P=0.47 and 0.222, respectively). There was a 1 (0.92%) Reverse Halo sign case in LLL and RLL lung lobes.

Overall, there were no significant differences between the two groups regarding the distribution of CON, GGO+CON, CRAZY, Reverse Halo sign, Subplural bands (Table 2).

The mean total score in the cancer group was 6.23±2.76 and in the control group was 5.87±2.23 (P=0.202). There were no significant differences between the two groups regarding mean scores in RUL, RML, RLL, and LUL. But, the mean score in the cancer group of LLL lung lobes was 1.46±0.94 and in the control group was 1.21±0.76. There was a significant difference between the two groups (P=0.010) (Table 2).

Table 2: Distribution of GGO, CON, GGO+CON, CRAZY, Reverse Halo sign, Subplural bands and by lung lobes in the two group

| Items | control | cancer | P-value |
|---|---|---|---|
| ICU admission | 27 (12.62%) | 45 (41.28%) | <0.001 |
| RUL | | | |
| GGO | 88 (41.12%) | 61 (55.96%) | 0.011 |
| CON | 61 (28.5%) | 24 (22.02%) | 0.211 |
| GGO+CON | 22 (10.28%) | 12 (11.01%) | 0.840 |
| CRAZY | 0 (0.0%) | 2 (1.83%) | 0.047 |
| Reverse Halo sign | 3 (1.40%) | 4 (3.67%) | 0.186 |
| Score | 1.16±0.82 | 1.14±0.74 | 0.590 |
| RML | | | |
| GGO | 87 (40.66%) | 51 (46.79%) | 0.422 |
| CON | 57 (26.64%) | 22 (20.18%) | 0.202 |
| GGO+CON | 27 (12.62%) | 11 (10.09%) | 0.505 |
| CRAZY | 1(0.47%) | 2 (1.83%) | 0.222 |
| Subplural bands | 0 (0.0%) | 1 (0.92) | 0.161 |
| Score | 1.02±0.72 | 1.08±0.81 | 0.54 |
| RLL | | | |
| GGO | 86 (40.19%) | 50 (45.86%) | 0.328 |
| CON | 63 (29.58%) | 25 (22.94%) | 0.206 |
| GGO+CON | 30 (14.02%) | 16 (14.68%) | 0.87 |
| Reverse Halo sign | 0 (0.0%) | 1 (0.92%) | 0.161 |
| Subplural bands | 3 (1.40%) | 4 (3.67%) | 0.186 |
| Score | 1.27±0.86 | 1.41±1.02 | 0.207 |
| LUL | | | |
| GGO | 91 (42.52%) | 47 (43.12%) | 0.918 |
| CON | 56 (26.54%) | 26 (23.85%) | 0.602 |
| GGO+CON | 28 (13.08%) | 12 (11.02%) | 0.592 |
| CRAZY | 0 (0.0%) | 1 (0.92%) | 0.161 |
| Subplural bands | 0 (0.0%) | 1 (0.92%) | 0.161 |
| Score | 1.18±0.82 | 1.12±0.88 | 0.58 |
| LLL | | | |
| GGO | 101 (47.20%) | 57 (52.29%) | 0.386 |
| CON | 50 (23.36%) | 26 (23.85%) | 0.922 |
| GGO+CON | 26 (12.15%) | 14 (13.73%) | 0.694 |
| Reverse Halo sign | 0 (0.0%) | 1 (0.92%) | 0.161 |
| Normal | 0 (0.0%) | 1 (0.92%) | 0.161 |
| Score | 1.21±0.76 | 1.46±0.94 | 0.010 |
| Total score | 5.87±2.23 | 6.23±2.76 | 0.202 |

## Discussion

This research aimed to evaluate lung CT outcomes in COVID-19 patients with cancer and non-cancer cases. Lobes of the left and right lung were affected equally by COVID-19 in both groups. Also, the involvement of lung lobes in the cancer group was higher than in the control group.

The GGO was the frequent finding in both groups, and it was higher in the cancer group than the control group, especially in the RUL lob. Also, consolidation was higher in the control group. In the current study, there was no statistically significant difference in the affected segment of lung lobes between cases with cancer and non-cancer.

Ostad et al. (2020) showed patch consolidation and environmental involvement, and ground-glass lesions are the most main findings of CT scans in Covid-19 patients (17). Ye et al. (2020) showed that Ground glass lesions and Consolidation are the most common CT scan findings in Covid-19 patients (18). Research on CT scan images of 55 cases in Iran showed right and left lower lobes are the most frequently involved lobes (19). A meta-analysis study on 2,738 patients revealed RLL and LLL were the most involved lung lobes (87.21% and 81.41%, respectively) (20). GGO was the most common result in most studies among different models (18-22).

Another study on CT scan images of 55 patients showed that right and left lower lobes are the more affected lobes (21). A meta-analysis on 2,738 participants also showed RLL and left lower lobe had the most affected lung lobes (87.21% and 81.41%, respectively) (21).

L. Zhang et al. reported the clinical characteristics of COVID-19-infected cancer patients at three hospitals in Wuhan, China, on 28 patients (17 men (60.7%)). This study showed that cancer patients showed worse conditions and a poorer prognosis for COVID-19 infection (22).

The GGO was the most frequent finding in most reports (18-22). The results are in agreement with Zhang et al.'s research (22) (2020) on COVID-19-disease cancer patients that GGO was the most common finding followed by consolidation. Vuagnat et al. (23) (2020) showed that the GGO was the most common outcome that was reported in at least half of breast cancer patients. Bai et al. (2020) showed GGO (91%) and consolidation (69%) were the most common outcomes (24).

A systematic review and meta-analysis of 15 retrospective studies including 2,451 patients with COVID-19 revealed that the crazy-paving pattern is significantly more common in severe than non-severe patients (20). But, there was not any significant difference between recovered and deceased groups.

In the current study, Crazy showed a significantly higher rate in cancer patients in RUL and RML lung lobes. It seems that a crazy-paving pattern might be used as an indicator of cancer patients in large populations.

ICU admission rate was significantly higher in the cancer group than in the control group. Zhang et al. (2020) assessed clinical characteristics of COVID-19-infected cancer patients in three hospitals in Wuhan, China (22). This study showed that cancer patients showed worse conditions and poorer prognoses for COVID-19 infection. Miyashita et al. (25) (2020) showed that a history of cancer could increase the intubation rate. Liang et al. (2020) found a significantly higher incidence of death and ICU admission in cases with cancer than non-cancer patients (26). Taghizadeh-Hesary et al. (2021) showed that the Covid-19 patients with cancer had a higher rate of mechanical ventilation and mortality. But, the admission rate was the same as the control group (27).

## Conclusion

The results showed that GGO and consolidation were common findings in CT images. GGO was higher in cancer patients. The involvement of lung lobes in the cancer group was higher than in the control group. ICU admission rate was significantly higher in cancer patients.

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None

## Abbreviations

Intensive Care Unit (ICU)
Ground Glass Opacities (GGO)
Consolidation (CON)
Mixed Ground Glass with Consolidation Opacities (GGO+CON)
RUL: right upper lobe
RML: right middle lobe
RLL: right lower lobe
LUL: left upper lobe
LLL: left lower lobe

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## Authors' Contributions

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## Ethical Statement

This study was approved by ethical committee of Arak University of Medical Sciences, Arak, Iran.

## References

1. Ronco C, Navalesi P, Vincent JL. Coronavirus epidemic: preparing for extracorporeal organ support in intensive care. The Lancet Respiratory Medicine. 2020;8(3):240-1.

2. The Lancet Infectious D. COVID-19, a pandemic or not? The Lancet Infectious Diseases. 2020.

3. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. New England Journal of Medicine. 2020.

4. Loeffelholz M. Clinical virology manual: John Wiley & Sons; 2016.

5. Song Z, Xu Y, Bao L, Zhang L, Yu P, Qu Y, et al. From SARS to MERS, thrusting coronaviruses into the spotlight. Viruses. 2019;11(1):59.

6. Kuiken T, Fouchier RA, Schutten M, Rimmelzwaan GF, Van Amerongen G, van Riel D, et al. Newly discovered coronavirus as the primary cause of severe acute respiratory syndrome. The Lancet. 2003;362(9380):263-70.

7. Drosten C, Gьnther S, Preiser W, Van Der Werf S, Brodt H-R, Becker S, et al. Identification of a novel coronavirus in patients with severe acute respiratory syndrome. New England journal of medicine. 2003;348(20):1967-76.

8. de Groot RJ, Baker SC, Baric RS, Brown CS, Drosten C, Enjuanes L, et al. Commentary: Middle East respiratory syndrome coronavirus (MERS-CoV): announcement of the Coronavirus Study Group. Journal of virology. 2013;87(14):7790-2.

9. Zaki AM, Van Boheemen S, Bestebroer TM, Osterhaus AD, Fouchier RA. Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. New England Journal of Medicine. 2012;367(19):1814-20.

10. Organization WH. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. http://www who int/csr/sars/country/table2004_04_21/en/index html. 2003.

11. Yang X, Yu Y, Xu J, Shu H, Liu H, Wu Y, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. The Lancet Respiratory Medicine. 2020.

12. Calisher C, Carroll D, Colwell R, Corley RB, Daszak P, Drosten C, et al. Statement in support of the scientists, public health professionals, and medical professionals of China combatting COVID-19. The Lancet. 2020;395(10226): e42-e3.

13. Organization WH. Coronavirus disease 2019 (COVID-19) situation reports. 2020. 2020.

14. Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, et al. Correlation of chest CT and RT-PCR testing in coronavirus disease 2019 (COVID-19) in China: a report of 1014 cases. Radiology. 2020:200642.

15. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, et al. Chest CT findings in coronavirus disease-19 (COVID-19): relationship to duration of infection. Radiology. 2020:200463.

16. Tian J, Yuan X, Xiao J, Zhong Q, Yang C, Liu B, et al. Clinical characteristics and risk factors associated with COVID-19 disease severity in patients with cancer in Wuhan, China: a multicentre, retrospective, cohort study. The Lancet Oncology. 2020;21(7):893-903.

17. Ostad SP, Haseli S, Iranpour P. CT Manifestation of COVID-19 Pneumonia; Role of Multiplanar Imaging. Acad Radiol. 2020 Apr 7. doi: 10.1016/j.acra.2020.03.028

18. Ye Z, Zhang Y, Wang Y, Huang Z, Song B. Chest CT manifestations of new coronavirus disease 2019 (COVID-19): a pictorial review. Eur Radiol. 2020 Mar 19: 1-9.

19. Bao C, Liu X, Zhang H, Li Y, Liu J. Coronavirus disease 2019 (COVID-19) CT findings: a systematic review and meta-analysis. Journal of the American college of radiology. 2020;17(6):701-9.

20. Zheng Y WL, Ben S. Meta-analysis of chest CT features of patients with COVID-19 pneumonia. Journal of Medical Virology. 2021;93(1):241-9.

21. Ashraf MA, Shokouhi N, Shirali E, Davari-tanha F, Memar O, Kamalipour A, et al. COVID-19 in Iran, a comprehensive investigation from exposure to treatment outcomes. MedRxiv. 2020.

22. Zhang L, Zhu F, Xie L, Wang C, Wang J, Chen R, et al. Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, China. Ann Oncol. 2020;31(7):894-901.

23. Vuagnat P, Frelaut M, Ramtohul T, Basse C, Diakite S, Noret A, et al. COVID-19 in breast cancer patients: a cohort at the Institut Curie hospitals in the Paris area. Breast Cancer Res. 2020;22(1):55.

24. Bai HX, Hsieh B, Xiong Z, Halsey K, Choi JW, Tran TML, et al. Performance of Radiologists in Differentiating COVID-19 from Non-COVID-19 Viral Pneumonia at Chest CT. Radiology. 2020;296(2): E46-54.

25. Miyashita H, Mikami T, Chopra N, Yamada T, Chernyavsky S, Rizk D, et al. Do patients with cancer have a poorer prognosis of COVID-19? An experience in New York City. Ann Oncol. 2020;31(8):1088-9.

26. Liang W, Guan W, Chen R, Wang W, Li J, Xu K, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. Lancet Oncol. 2020;21(3):335-7.

27. Taghizadeh-Hesary F, Porouhan P, Soroosh D, PeyroShabany B, Shahidsales S, Keykhosravi B, Rahimi F, Houshyari M, Forouzanfar MM, Javadinia SA. COVID-19 in Cancer and Non-Cancer Patients. International Journal of Cancer Management. 2021 Apr 30;14(4). role of pain sensitivity. Pain physician. 2013;16: E715-E23.