Original Research Article

DIFFERENTIAL DIAGNOSIS OF COMMUNITY-ACQUIRED PNEUMONIA FROM COVID-19 BY COMPUTED TOMOGRAPHY

PASHA N[*1], AKRAM MN[2], WAQAR N[3], PASHA K[4]

[1]*Department of Radiology, CH & ICH Multan, Pakistan*
[2]*Department of Radiology, Sahara Medical College Narowal, Pakistan*
[3]*Department of Radiology, Town Hospital Rahimabad Multan, Pakistan*
[4]*Department of Radiology, Ghauri Diagnostics, Multan, Pakistan*
*Correspondence author email address: drmaria123@yahoo.com

Abstract: *The retrospective study was conducted on data collected from tertiary Care Hospitals from January 2020 to May 2021 to compare CT manifestations and clinical features of COVID-19 with CAP and evaluate the diagnostic accuracy of CT in patients with COVID-19 and CAP. The study included one hundred sixty patients with COVID-19 and 115 with CAP diagnosed during the same time. Clinical data and CT images of the participants were collected. Results showed that 134 (84.3%) patients in the COVID-19 group had ground glass opacities on CT scans. In the COVID-19 group, the typical early presentation was single or multiple small round lesions. 51 (31.8%) patients had small lesions, and 83 (51.8%) had large patches, areas of fusion, or density shadows with spots. In the CAP group, 69 (60%) patients had consolidation, and 45 (39.1%) had ground glass shadows. There was a significant difference in density between both groups (P <.001). Of observed imaging and clinical manifestations, ground glass shadows, number of leukocytes, and age factor are clinically significant in diagnosing COVID-19. In the CAP group, major characteristics were the thickening of the bronchial wall, accumulation of textures and fibrous cords, and consolidated lung lesions. In COVID-19, common imaging manifestations of GGO and consolidation. Clinically, a CT scan should be used along with history and examination for early and accurate diagnosis of COVID-19.*

Keywords: COVID-19, Community-Acquired Pneumonia, Computed Tomography

Introduction

COVID-19 is an infectious disease caused by SARS-CoV-2(Zhu et al., 2020a). Its symptoms include dyspnea, shortness of breath, fever, and cough. In severe cases, infection may lead to severe acute respiratory syndrome, pneumonia, renal failure and death (Chen et al., 2020; Wang et al., 2020). Coronavirus nucleic acid test is the gold standard for COVID-19 detection (Zhang et al., 2020), but treatment can be delayed due to false negative or late results. Chest computed tomography (CT) is used clinically for diagnosing COVID-19, which has certain imaging characteristics (Carotti et al., 2020). Early disease detection is important to prevent the spread of infection and provide timely treatment.

Studies have been conducted on patterns and imaging characteristics of COVID-19 (Liu et al., 2020b; Zhu et al., 2020b). It is important to distinguish COVID-19 from other diseases like community-acquired pneumonia (CAP). However, there are limited imaging-based comparative studies on this topic. This study aims to compare CT manifestations and clinical features of COVID-19 with CAP and evaluate the diagnostic accuracy of CT in patients with COVID-19 and CAP.

Methodology

The retrospective study was conducted in tertiary care hospitals from January 2020 to May 2021. Patients with COVID-19 and CAP who underwent CT scan examination were included in the study. Patients with lung cancer, organ transplant abnormal immune function, and negative respiratory pathogen panel (CAP-RPP) were excluded. The study included one hundred sixty patients with COVID-19 and 115 with CAP diagnosed during the same time. Pathogens were confirmed by reverse transcription–polymerase chain reaction (RT PCR) and blood tests. Informed consent of the participants was taken. The ethical committee of the hospital approved the study.

Clinical data and CT images of the participants were collected. CT images of the CAP and COVID-19 group were interpreted by two experienced radiologists who rad the images independently. The radiologist recorded the lesion's size, shape, location, number, extent, and edge pattern.

SPSS version 23.0 was used for data analysis. Measurement data was represented as mean ± SD, and inter-group comparison was done by independent *t*-test. Count data was represented as frequency and percentage, and inter-group comparison was done by χ^2 test. The relationship between CT finding and COVID-19 were analyzed by correlation analysis. P value < 0.05 was considered statistically significant.

Results

The clinical characteristics of both groups are summarized in Table I. Mean age of the patients with COVID-19 was 45.2 ± 17.5 years, and with CAP was 15.5 ± 21.5 years. The

differences in white blood cell (WBC) count ($P < .001$), age ($P < .001$), presence or absence of underlying disease ($P < .001$), and lymphocyte proportion ($P = .003$) were significant.

The CT findings of patients with COVID-19 and CAP are shown in Table II. 134 (84.3%) patients in the COVID-19 group had ground glass opacities on CT scans. In the COVID-19 group, the typical early presentation was single or multiple small round lesions. 51 (31.8%) patients had small lesions, and 83 (51.8%) had large patches, areas of fusion, or density shadows with spots. In the CAP group, 69 (60%) patients had consolidation and 45 (39.1%) had ground glass shadows. There was a significant difference in density between both groups (P <.001).

Total lung lobes affected in the CAP and COVID-19 groups were 252 and 380, respectively. The COVID-19 group had significantly more single lesions than the CAP group (P=.03), while multi-lobar foci were significantly more in the CAP group than the COVID-19 group (P=.01). 59 (51.3%) patients in the CAP group and 142 (88.7%) in the COVID-19 group had lesions in the outer zone. This difference was statistically significant (P<.001). Age of onset was positively correlated with the number of lobar segments affected ($P < .001$).

Of observed imaging and clinical manifestations, ground glass shadows, number of leukocytes, and age factor are clinically significant in diagnosing COVID-19. In the CAP group, major characteristics were the thickening of the bronchial wall, accumulation of textures and fibrous cords, and consolidated lung lesions.

Table I Comparison of clinical manifestations and baseline data between study groups

	COVID-19 Group	CAP Group	P value
Gender			
Male	75	47	.37
Female	85	68	
Mean age	45.2 ± 17.5	15.5 ± 21.5	<.001
Fever			
Yes	145	100	.47
No	15	15	
Chest tightness			
Yes	34	25	.62
No	126	90	
Muscle soreness			
Yes	45	23	.03
No	115	92	
Fatigue			
Yes	51	21	.02
No	109	94	
Cough			
Yes	82	70	.15
No	78	45	
Expectoration			
Yes	32	61	<.001
No	128	54	
Headache			
Yes	12	7	.16
No	148	108	
Diarrhea			
Yes	5	5	.05
No	155	110	
WBC($\times 10^9$/L)	9.61 ± 5.11	$5.9\ 1 \pm 3.02$	<.001
C-reactive protein (mg/L)	27.81 ± 34.50	46.91 ± 56.67	.078
Neutrophil proportion (%)	68.13 ± 15.28	61.69 ± 23.62	.08
Lymphocyte proportion (%)	22.36 ± 12.15	46.13 ± 18.37	<.001
ESR(mm/h)	32.55 ± 24.12	57.54 ± 29.91	.08
Calcitonin(mg/ml)	$.51 \pm .69$	$.39 \pm .38$	.61

Table II Comparison of CT manifestation between study groups

	COVID-19 Group n(%)	CAP Group n(%)	P value
Pathological morphology and density			
Large and small mixed patch consolidation	12 (7.5%)	32 (27.8%)	.53
Small patch consolidation	13 (8.1%)	30 (26%)	<.001
Ground glass and solid shadow	10 (6.2%)	6 (5.2%)	.66
Large and small ground glass shadow	17 (10.6%)	4 (3.4%)	.04

Large ground glass shadow	22 (13.7%)	11 (10.4%)	.07
Small ground glass shadow	33 (20.6%)	26 (22.6%)	.74
Other imaging signs			
Lung bullea	0	7 (6%)	<.001
Pulmonary cavity	0	11 (9.5%)	<.001
Crazy paying pattern	52 (32.5%)	32 (27.8%)	.48
Bronchial wall thickening	17 (10.6%)	35 (30.4%)	<.001
Air bronchgram	5 (3.1%)	44 (38.2%)	.19
Fibrous tissue	5 (3.1%)	65 (65.5%)	<.001
Lesion wandering	20 (12.5%)	3 (2.6%)	.002
Distribution			
Central	16(10%)	21 (18.2%)	.04
Peripheral	96 (60%)	60 (52.1%)	.21
Number of lobes and lesions involved			
Multilobed multiple lesions	101 (63.1%)	89 (77.3%)	.01
Single leaf multiple occurrence	12 (7.3%)	8 (6.9%)	.91
Single leaf single shot	46 (28.7%)	16 (13.6%)	.03
Other chest diseases			
Lymphadenopathy	1 (.6%)	17 (14.7%)	<.001
Plural effusion	2 (1.2%)	19 (16.5%)	<.001
Plural thickening	3 (1.8%)	29 (25.2%)	<.001

Discussion

SARS-CoV-2 has high infectivity and is associated with a high mortality rate. Thus, early diagnosis is important and challenging. Due to limited sensitivity and delayed laboratory reports, early diagnosis methods remain controversial (Lin et al., 2020). Thoracic imaging has an important role in diagnosis. Chest CT scans can provide important information for differential diagnosis of COVID-19. In this study, we compared CT manifestations and clinical features of COVID-19 with CAP and evaluated the diagnostic accuracy of CT in patients with COVID-19 and CAP. In both groups, fever was a common clinical manifestation; however, the rise in temperature in the COVID-19 group was more prominent. During the initial stages, patients with COVID-19 show a decreasing trend in leukocyte count. This finding is similar to a previous study (Huang et al., 2020). Fatigue and muscle soreness were more prevalent in the COVID-19 group than the CAP group; expectoration was more prevalent in CAP compared to the COVID-19 group. The results suggested that the incidence of diabetes, chronic lung disease, hypertension, and heart disease was significantly higher in CAP compared to the COVID-19 Group.

The results showed that 84% of COVID-19 CT images had ground glass opacities. This finding is consistent with the results of previous studies. Moreover, single lesions were more prevalent in the COVID-19 group than compared to the CAP group (Li et al., 2020; Ye et al., 2020). With disease progression, GGO expands and develops into areas of fusion representing ground glass shadows, but there is little change in density, unlike rapid consolidation seen in the CAP group. In the COVID-19 group, there are reticular shadows overlapped by ground glass shadows, and it may be due to alveolar edema and thickening of the alveolar septum (Tian et al., 2020).

In the CAP group, exudative inflammation was accompanied by texture aggregation or fibrous components, manifesting as bronchitis, suggesting previous lung inflammation in these patients. This contrasts with acute onset, multiple manifestations, and rapid progression of lung inflammation in COVID-19. Thus, the results suggest that bronchial wall thickening and fibrous cord indicate CAP. Similar findings were reported in a previous study (Liu et al., 2020a). Moreover, the results show that the CAP group had pulmonary bullae, "mosaic" signs, reticular changes, and emphysema in the consolidation area. The current study shows that the onset age positively correlated with some lobar segments affected. The number of segments affected in the COVID-19 group was significantly higher than the CAP group, as reported by previous studies (Jiang et al., 2022; Shama et al., 2023). The limitation of this study is retrospective design and selection bias in the screening strategy. A larger prospective study is recommended.

Conclusion

In COVID-19, common imaging manifestations of GGO and consolidation. Clinically, a CT scan should be used along with history and examination for early and accurate diagnosis of COVID-19.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned.
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared absence of conflict of interest.

References

Carotti, M., Salaffi, F., Sarzi-Puttini, P., Agostini, A., Borgheresi, A., Minorati, D., Galli, M., Marotto, D., and Giovagnoni, A. (2020). Chest CT features of coronavirus disease 2019 (COVID-19) pneumonia: key points for radiologists. *La radiologia medica* **125**, 636-646.

Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Qiu, Y., Wang, J., Liu, Y., and Wei, Y. (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *The lancet* **395**, 507-513.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., and Gu, X. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The lancet* **395**, 497-506.

Jiang, Y., Rubin, L., Peng, T., Liu, L., Xing, X., Lazarovici, P., and Zheng, W. (2022). Cytokine storm in COVID-19: from viral infection to immune responses, diagnosis and therapy. *International journal of biological sciences* **18**, 459.

Li, X., Zeng, W., Li, X., Chen, H., Shi, L., Li, X., Xiang, H., Cao, Y., Chen, H., and Liu, C. (2020). CT imaging changes of corona virus disease 2019 (COVID-19): a multi-center study in Southwest China. *Journal of translational medicine* **18**, 1-8.

Lin, C., Ding, Y., Xie, B., Sun, Z., Li, X., Chen, Z., and Niu, M. (2020). Asymptomatic novel coronavirus pneumonia patient outside Wuhan: the value of CT images in the course of the disease. *Clinical imaging* **63**, 7-9.

Liu, K.-C., Xu, P., Lv, W.-F., Chen, L., Qiu, X.-H., Yao, J.-L., Gu, J.-F., Hu, B., and Wei, W. (2020a). Differential diagnosis of coronavirus disease 2019 from community-acquired-pneumonia by computed tomography scan and follow-up. *Infectious diseases of poverty* **9**, 1-11.

Liu, K.-C., Xu, P., Lv, W.-F., Qiu, X.-H., Yao, J.-L., Gu, J.-F., and Wei, W. (2020b). CT manifestations of coronavirus disease-2019: a retrospective analysis of 73 cases by disease severity. *European journal of radiology* **126**, 108941.

Shama, M., Mahmood, A., Mehmood, S., and Zhang, W. (2023). Pathological Effects of SARS-CoV-19 Associated With Hematological Abnormalities.

Tian, S., Hu, W., Niu, L., Liu, H., Xu, H., and Xiao, S.-Y. (2020). Pulmonary pathology of early-phase 2019 novel coronavirus (COVID-19) pneumonia in two patients with lung cancer. *Journal of thoracic oncology* **15**, 700-704.

Wang, D., Hu, B., Hu, C., Zhu, F., Liu, X., Zhang, J., Wang, B., Xiang, H., Cheng, Z., and Xiong, Y. (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. *jama* **323**, 1061-1069.

Ye, Z., Zhang, Y., Wang, Y., Huang, Z., and Song, B. (2020). Chest CT manifestations of new coronavirus disease 2019 (COVID-19): a pictorial review. *European radiology* **30**, 4381-4389.

Zhang, N., Wang, L., Deng, X., Liang, R., Su, M., He, C., Hu, L., Su, Y., Ren, J., and Yu, F. (2020). Recent advances in the detection of respiratory virus infection in humans. *Journal of medical virology* **92**, 408-417.

Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., Zhao, X., Huang, B., Shi, W., and Lu, R. (2020a). A novel coronavirus from patients with pneumonia in China, 2019. *New England journal of medicine* **382**, 727-733.

Zhu, Y., Gao, Z.-H., Liu, Y.-L., Xu, D.-Y., Guan, T.-M., Li, Z.-P., Kuang, J.-Y., Li, X.-M., Yang, Y.-Y., and Feng, S.-T. (2020b). Clinical and CT imaging features of 2019 novel coronavirus disease (COVID-19). *Journal of Infection* **81**, 147-178.