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EXAMİNATİON OF RADİOLOGİCAL FİNDİNGS OF PCR-POSİTİVE PATİENTS FOLLOWED İN COVID-19 INTENSİVE CARE UNİTS

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ABSTRACT

Introduction; Since the Coronavirus disease (COVID-19), which emerged in China in 2019 and created a pandemic in a short time, affected all systems, primarily affecting the respiratory system and progresses with mild to severe pneumonia, computerized thorax tomography (CT) is used to evaluate the progression of the disease and make its differential diagnosis.) has become the imaging method of first choice. **Material-Method;** 311 patients who had a positive PCR test and were followed up in the intensive care unit of our hospital between March 2020 and June 2021 were included. The first CT reports at the time of application were examined. The patient's gender, age, side, and localization findings, and appearance characteristics of the lesions on thorax CT were examined. SPSS was used for statistical analysis, the Pearson Chi-square test was used to evaluate categorical variables, and the Fischer Exact test was used when Chi-square test conditions were not met. Compliance of continuous variables with normal distribution was determined using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Student's T test between two independent groups for continuous variables with normal distribution (parametric); Those that did not comply with normal distribution (non-parametric) were compared using the Mann-Whitney U test. **Findings;** The fact that the most common typical finding obtained in this study data is ground glass, appearing in the first 5 days of the disease and then consolidating in the following days, suggests that the application is a result of later presentation. **Conclusion;** In COVID-19 viral pneumonia, thorax CT plays an important role not only in diagnosis but also in determining the severity of the disease at the time of diagnosis, revealing possible complications, and in the follow-up process.

KEYWORDS: Computer Tomography, COVID-19, Intensive Care Unit.

INTRODUCTİON

In December 2019, coronavirus (2019-nCoV), also known as Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2), emerged in Wuhan, China, and in March 2020, the World Health Organization (WHO) determined that the virus caused a pandemic. It has been declared open.[1] COVID-19 disease has a wide clinical spectrum and the clinical conditions that may develop are asymptomatic disease, mild upper respiratory tract disease, atypical pneumonia, severe respiratory failure and acute respiratory distress syndrome, sepsis multiple organ failure, and death. The most common symptoms during the course and initial period of the disease are; These can be listed as fever, cough, shortness of breath, sore throat, muscle-joint pain, weakness, and decreased sense of taste and smell.[2]

Although the gold standard diagnostic method is the real-time polymerase chain reaction (RT-PCR) performed on a swab sample taken from the nose and throat, radiological imaging has also been used extensively because the test results take time and false negativity may develop.[3] One of the imaging methods computed thorax tomography (CT). CT) has played an important role in staging and patient follow-up as well as diagnosis.[2] In studies, the early sensitivity of the PCR test was found to be 71%, while CT was found to be 98%.[4]

In light of this information, our study aimed to examine the place of CT findings of COVID-19 pneumonia in reaching a rapid diagnosis the decision to hospitalize the patient, and the relationship between the CT findings taken during the first admission to the emergency department and the progression of patients followed in intensive care.

In practice, various classifications have been used for CT findings of COVID-19 pneumonia. Among the most used are the BSTI (British Society of Thoracic Imaging) Classification and CO-RADS (COVID-19 Reporting and Dara System) (Tables 1 and 2).[5]

Table 1: BSTI (British Society of Thoracic Imaging) Classification.

Pattern	Description
Classic COVID-19 (100% reliable)	Multiple, bilateral* ground glass opacities, predominantly lower lobe and peripheral. Cobblestone sign. Peripheral consolidation. Air bronchogram. Inverted halo/per lobular pattern**
Possible COVID-19 (71-99% reliable)	Lower lobe dominant, bronchogenic, and peripheral consolidation Inverted halo/per lobular pattern** Limited number of ground glass opacities
Uncertain (under 70% reliable)	Findings that do not fit into the other three groups radiologically show these patterns but clinically suggest an alternative diagnosis (for example, interstitial lung disease, connective tissue disease)
Incompatible, non-COVID-19 (70% reliable for alternative diagnosis)	Incompatible, non-COVID-19 (70% reliable for alternative diagnosis) Lobar pneumonia Cavitary infection Bud branch appearance/centrilobular nodules Lymphadenopathy, effusion Diffuse pulmonary fibrosis

*>1 lesion, may be unilateral. **Organized pneumonia patterns.

Table 2: CO-RADS classification.[5]

Degree	Findings
CORADS-0	Not rated Insufficient review
CORADS-1	Very low Normal or findings other than infection
CORADS-2	Low Typical findings for other infections (lobar consolidations, cavity)
CORADS-3	Moderate Findings seen in both COVID-19 and other diseases (ground glass, pulmonary edema, opacities)
CORADS-4	Highly suspicious/possible findings for COVID-19 (Typical findings are unilateral, not close to the visceral pleura, peri broncho vascular predominantly located lesions)
CORADS-5	Very High Typical findings for COVID-19 (bilateral and multifocal, ground glass opacities adjacent to the visceral pleura, including fissures, with or without consolidation)
CORADS-6	Patients with positive PCR and CT findings with a definitive diagnosis

Chest computed tomography findings

Typical findings in COVID-19-related pneumonia and the change of these findings in the course of the disease and atypical findings have been described in many studies.[7] However, similar radiological findings are also encountered in other viral pneumonia, especially influenza, and in cases such as drug toxicities. In the early stages of the disease, the radiological image may be completely normal; however, respiratory artifacts, shooting errors, increased density, mosaic pattern, and ground glass appearance cause confusion.[8]

Radiological Staging; The disease can be divided into four stages according to the change in thorax CT appearances of COVID-19 patients.[9,10]

Early period: This is the period covering the first 4 days from the onset of symptoms. During this period, ground glass opacities located subpleurally in the unilateral or bilateral lower lobes are the main radiological findings.

Progression period: 5–8 days from the day the symptoms of the disease begin. It covers days. Radiological findings are bilateral, diffuse, multilobar ground glass opacities and consolidations.

Peak period: 9-13 days from the day the symptoms of the disease begin. It covers days. During this period, the infiltration areas in the lungs progress slowly and reach their highest level. Areas of intense consolidation are more evident, parenchymal bands can be seen. There may be frosted glass, cobblestone appearance, and consolidations.

Resolution period: It covers the 14th day and beyond, the infection is now under control. Consolidation areas have begun to recede and their cobblestone appearance has disappeared. Widespread ground glass opacities may be seen due to regression of consolidation areas. Sequelae fibrotic bands may occur.

The Fleischner Society has published its recommendations against different simultaneous clinical scenarios for imaging in COVID-19 pneumonia.[11] These recommendations are summarized in Table 3.

Table 3: COVID-19 Fleischner Society lung imaging recommendations.[10]

1. It is not recommended as a routine screening test in asymptomatic patients.
2. It is not recommended for patients with mild clinical findings* and if there are no risk factors for disease progression.
3. Imaging is recommended regardless of the COVID-19 test result in patients with moderate/severe clinical*.
4. Imaging is recommended in case of respiratory deterioration in test-positive patients.
5. In cases where resources are limited**, lung imaging is recommended in patients with moderate/severe clinical conditions and in people with a high probability of testing positive.
*Mild to moderate/severe clinical conditions are divided according to whether there are signs of severe respiratory dysfunction or damage. **Indicates situations requiring rapid triage in case of shortage of personnel, protective equipment, COVID-19 testing, hospital beds, and/or ventilators.

1. Frosted glass appearance; It is the most common finding and is one of the patchy, round-shaped findings in the early phase of mild pneumonias.
2. Consolidation; These are opacities seen in the lung parenchyma in severe pneumonia.
3. Air bronchogam; It is one of the expected findings in severe pneumonia.
4. Vascular expansion; They are enlargements of the vascular structures in or around the pulmonary opacity.
5. Cobble stone finding; These are septal thickenings seen in the progression phase of the disease.
6. Thickening of bronchial walls; It is a thickening due to inflammation in the bronchial wall that occurs in the late period.
7. Halo sign, nodule; It is seen in the early phase and describes a nodule surrounded by ground glass.
8. Fibrosis; It is the thickening in the interstitial area seen in late or severe pneumonia.
9. Reticulation; These are the lines in the intralobular area that are seen in the late period.
10. Pleural thickening; It is a late symptom and is adjacent to consolidation.

MATERIAL-METHOD

Our study included 311 patients who had a positive PCR test and were followed up in the intensive care unit of our hospital between March 2020 and June 2021. The first CT reports of the patients when they applied to the emergency department were examined and the reports were reported by the radiology unit of our hospital, and the information was accessed through the hospital automation system. Thoracic CT examinations were performed with a 16-slice CT device (Toshiba Alexion 16), with a slice thickness of 3 mm, in the supine position and with an appropriate thorax protocol (kV: 100-120, mAs: 50-100). The patient's gender, age, side, localization findings, and appearance characteristics of the lesions on thorax CT were examined. While ground glass areas, consolidation, consolidation with ground glass area, and vascular dilatations are classified as typical CT findings; Septal thickening, cavity, air bronchogram, pleural effusion, fibrosis, and nodule were considered atypical CT findings. CORADS classification was made for each patient based on CT findings. Ethics committee approval was received from the Kastamonu University Faculty of Medicine ethics committee in June 2021.

Statıstıcal analyses: Statistical analyses were performed using Statistical Package for the Social Science for Windows software version 28 (SPSS Inc; Chicago, USA). In descriptive statistics, number (n) and percentage (%) were stated for categorical variables. Mean and standard deviation (SD) for normally distributed (parametric) continuous variables; For non-normally distributed (non-parametric) continuous variables, median and distribution range were specified.

Pearson Chi-square test and Fischer Exact test were used to evaluate categorical variables when Chi-square test conditions were not met. Compliance of continuous variables with normal distribution was determined using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Student's T test between two independent groups for continuous variables with normal distribution (parametric); Those that did not comply with normal distribution (non-parametric) were compared using the Mann-Whitney U test.

A P value of less than 0.05 was considered statistically significant.

RESULTS

The information of a total of 311 patients with positive PCR tests and thorax CT results, who were followed up in the COVID-19 intensive care units of our hospital, was accessed. The number of female patients is 161, and the number of male patients is 150. The average age of the patients was calculated as 75± 11.35. The most frequently observed typical CT finding was bilateral ground glass density (93.4%), the second additional common finding was bilateral consolidation (84.9%), and the most frequently observed atypical CT finding was pleural effusion (24.2%). The least common thorax CT finding was cavity (0.3%).

When the results of the CORADS classification are analyzed; CORADS V was seen at 40.3%, CORADS IV at 25.2%, CORADS III at 15.8%, CORADS II at 7.2%, CORADS I at 5.8%, CORADS VI at 5.5%, respectively. The analysis results are given in Table 5.

Table 4: CT findings analysis.

	Min-Mak	Ort.±ss/n-%
Age	**22- 97**	**11,35,75,0**
Consolidation	119	38,4 %
consolidation -bilaterality	101	84.9 %
frosted glass	260	83,9 %
ground glass-bilaterality	241	93,4 %
air bronchogram	9	2,9 %
vascular expansion	19	6,1 %
bronchial changes	33	10,6 %
mediastinal lap	50	16,1 %
pleural effusion	75	24,2 %
pericardial effusion	5	1,6 %
paving stone	4	1,3 %
cavity	1	0,3 %
pneumothorax	3	1,0 %
nodule/mass	19	6,1 %
emphysema	45	14,5 %
bronchiectasis	10	3,2 %
pulmonary edema	16	5,2 %
ards	10	3,2 %
fibrosis	36	11,6 %
atelectasis	72	23,2 %

When the patients were divided into two groups men and women and analyzed; The age of female patients was found to be significantly higher than male patients ($p<0.05$). In the comparison made in terms of CT findings, consolidation, bilateral consolidation, bilateral ground glass, vascular expansion, bronchial changes, mediastinal LAP, pleural effusion, pericardial effusion, cobblestone, cavity, pneumothorax, nodule/mass, bronchiectasis, pulmonary edema, ARDS, fibrosis rate were evaluated for each There was no significant difference between the two groups ($p>0.05$). While the incidence of ground glass ($p = 0.034$) and emphysema ($p = 0.012$) in female patients was significantly higher than in males; Air bronchogram ($p=0.014$) and atelectasis ($p=0.017$) were significantly higher in male patients than in females. There was no significant difference between genders in the evaluation in terms of CORADS classification ($p>0.05$). The evaluations mentioned are shown in Table 5.

Table 5: Thorax CT findings according to gender.

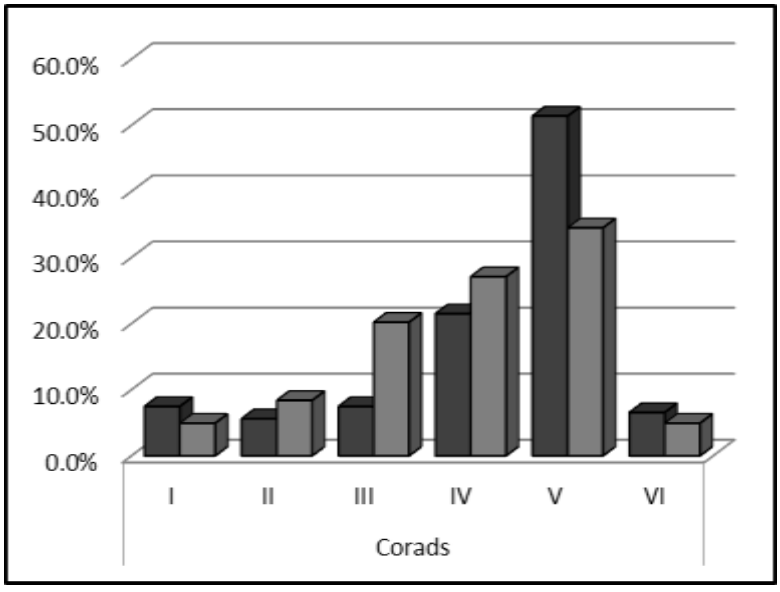
	Man		Woman			
	Average .±ss/n-%	**Medyan**	**Avarage ±ss/n-%**		**Medyan**	**p**
Age	**72.29±**	**11.67,72.00**	**77,18 ± 10,10**		**78,00**	**0,000t**
Consolidation	48	42.1%	71	36.2%		0.305 X^2
Bilateral Consolidation	37	77.1%	64	90.1%		0.051 X^2
Frosted glass	89	78.1%	171	87.2%		0.034 X^2
Ground Glass-Bilaterality	80	90.9%	161	94.7%		0.244 X^2
Air Bronchogamy	7	6.1%	2	1.0%		0.014 X^2
Vascular Expansion	10	8.8%	9	4.6%		0.139 X^2
Bronchial Changes	11	9.6%	22	11.2%		0.665 X^2
Mediastinal Lap	16	14.0%	34	17.3%		0.445 X^2
Pleural Effusion	33	28.9%	42	21.4%		0.136 X^2
Pericardial Effusion	2	1.8%	3	1.5%		1.000 X^2
Paving stone	1	0.9%	3	1.5%		1.000 X^2
cavity	0	0.0%	1	0.5%		1.000 X^2
pneumothorax	0	0.0%	3	1.5%		0.300 X^2
Nodule/Mass	3	2.6%	16	8.2%		0.050 X^2
emphysema	9	7.9%	36	18.4%		0.012 X^2
bronchiectasis	4	3.5%	6	3.1%		0.830 X^2
Pulmonary Edema	6	5.3%	10	5.1%		0.951 X^2
ARDS	4	3.5%	6	3.1%		0.830 X^2
fibrosis	11	9.6%	25	12.8%		0.410 X^2
Atelectasis	35	30.7%	37	18.9%		0.017 X^2

When patients were examined by dividing them into those under and over 70 years of age; There was no significant difference between the two groups in terms of consolidation, ground glass, air bronchogram, vascular dilation, bronchial changes, pericardial effusion, cobblestone, cavity ratio, emphysema, bronchiectasis, ARDS, fibrosis and atelectasis (p>0.05). Bilateral consolidation (p = 0.024), bilateral ground glass (p = 0.033), mediastinal lap (p < 0.001), pneumothorax (p = 0.04), and nodule-mass (p = 0.007) in the group aged <70 years compared to the group under 70 years of age. was found to be significantly high. In the group aged >70 years, pleural effusion (p = 0.006) and pulmonary edema (p = 0.015) were significantly higher (Table 6).

Table 6: Thorax CT findings according to age.

	Age <70		Age >70			
	Average .±ss/n-%		Average .±ss/n-%		p	
Consolidation	41	38.3%	78	38.4%	0.985	X^2
Consolidation -Bilaterality	39	95.1%	62	79.5%	0.024	X^2
Frosted glass	92	86.0%	168	82.8%	0.463	X^2
Ground Glass-Bilaterality	90	97.8%	151	91.0%	0.033	X^2
Air Bronchogamy	3	2.8%	6	3.0%	0.940	X^2
Vascular Expansion	4	3.7%	15	7.4%	0.203	X^2
Bronchial Changes	12	11.2%	21	10.3%	0.813	X^2
Mediastinal Lap	28	26.2%	22	10.8%	0.000	X^2
Pleural Effusion	16	15.0%	59	29.1%	0.006	X^2
Pericardial Effusion	3	2.8%	2	1.0%	0.345	X^2
Paving stone	1	0.9%	3	1.5%	1.000	X^2
cavity	1	0.9%	0	0.0%	0.345	X^2
pneumothorax	3	2.8%	0	0.0%	0.040	X^2
Nodule/Mass	12	11.2%	7	3.4%	0.007	X^2
emphysema	16	15.0%	29	14.3%	0.874	X^2
bronchiectasis	2	1.9%	8	3.9%	0.326	X^2
Pulmonary Edema	1	0.9%	15	7.4%	0.015	X^2
ARDS	5	4.7%	5	2.5%	0.295	X^2
fibrosis	9	8.4%	27	13.3%	0.201	X^2
Atelectasis	21	19.6%	51	25.1%	0.276	X^2

The CORADS findings of patients over the age of 70 and young patients under the age of 70 are summarized in the graph provided. It was observed that advanced CORADS findings (V, VI) were more common under the age of 70 (Figure 1).



Age<70, Age>70

Figure 1: CORADS classification of patients over 70 years of age and under 70 years of age.

DİSCUSSİON

While direct chest X-ray evaluations were recommended at the beginning of the pandemic to prevent possible contamination and ensure service continuity, later on, chest CT began to be preferred due to its high diagnostic sensitivity. In a meta-analysis of symptomatic patients in the literature, the sensitivity of thorax CT in the diagnosis of COVID-19 was found to be 93-97% and the specificity was found to be 25-72%.[11] Viral pneumonia may be difficult to interpret because its CT imaging features may be similar to other causes and involvements of acute lung injury and organizing pneumonia.[12] The fact that the most common typical finding obtained in this study data is ground glass, appearing in the first 5 days of the disease and then consolidating in the following days, suggests that the application is a result of later presentation. It may be possible to say that patients with consolidated areas are admitted to the hospital later.

Findings such as mediastinal LAP, cavity, pleural effusion, halo, and nodule, which we can count among the atypical findings, are rare findings in COVID-19 pneumonia and are more typical for other diseases (tuberculosis, necrotizing pneumonia, aspiration pneumonia). There are some limitations in our study. While the patients had CT findings and were followed up in COVID intensive care units, patients with negative PCR tests were not included in the study, which caused a decrease in the number of patients included in the study. Immunosuppression causes false negatives, other viral infections, malignancies, low virus load, and not taking the test correctly; There are CT findings and PCR results are negative.

In this study, we examined the thorax CT findings in COVID-19 intensive care units in Kastamonu province and compared them with different centers. In our study, the ground glass area rate in Thorax CT was 93.4% and the consolidation rate was 84.9%, while these rates were compared to Salehi et al. In his study, the rates were found to be 88% for ground glass field and 32% for consolidation.[13] In a study conducted in Italy, the ground glass area was found to be 99% and consolidation was 83%.[14] In the study conducted by Zhou et al. (2020), chest CT images of 62 confirmed COVID-19 patients who did not receive any antiviral treatment between January 21 and February 4, 2020, in Chongqing, China were examined. The most common findings as a result of CT examinations were; ground glass opacity (61.3%) and consolidated ground glass opacity (35.5%). The ground glass and consolidation findings in our study were observed to be similar to the literature.

Pleural effusion, our most common atypical finding, was found to be 24.2% in our study, while it was found to be 8% in similar studies.[15] Lung nodules have been reported in approximately 3-13% of COVID-19 patients in many studies.[16] In our study, the nodule incidence rate was approximately 8.2% and was found to be similar to the literature. Information regarding the prognosis of fibrosis in COVID-19 patients is controversial, but some studies show improvement and chronicity in stable patients, and there are studies with a rate of up to 17% in the literature.[16] In our study, the finding of fibrosis was found to be 16%. In the study conducted by Ye et al. (2020), chest CT scan results of COVID-19 cases were examined through images. According to the results, a bilateral ground glass appearance and consolidation were specifically observed in the chest CT images of COVID-19 patients. Other findings: reticular pattern, lobular septal thickening with variable alveolar filling (crazy-paving pattern), air bronchogram, pleural changes, airway changes, oblique subpleural striation, fibrosis, vascular dilatation, air bubble, nodule, halo sign, reverse halo sign, ATOL sign, lymphadenopathy and pericardial effusion

In our study, it was observed that the CORADS-5-6 results with advanced involvement in patients under the age of 70 who were followed up in the intensive care unit were higher than those over the age of 70. There is no similar information in the literature, we think we have contributed.

In COVID-19 viral pneumonia, thorax CT plays an important role not only in diagnosis but also in determining the severity of the disease at the time of diagnosis, revealing possible complications, and in the follow-up process. Different visual and quantitative scoring systems have been used based on the percentage of involvement per lobe in thorax CT, and it has been stated that disease severity and prognosis can be determined in this way. All patients included in our study were followed in the COVID-19 intensive care unit. These are patients who require advanced life support.

CONCLUSİON

COVID-19 viral infection spread rapidly all over the world, infected a large number of people, was considered a pandemic, and caused millions of deaths. There is no definitive treatment yet, symptomatic and supportive treatments are still applied, and the most effective method is prevention. Early detection and isolation of patients with COVID-19 clinical and radiological findings are extremely important for public health.

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