Comparing the Computed Tomography Findings of the Covid-19 PCR Positive Patients in Intensive Care Unit and PCR Negative Suspected Patients in Terms of Clinical and Laboratory Data

Yoğun Bakım Ünitesindeki Covid-19 PCR Pozitif ve PCR Negatif Şüpheli Hastaların Bilgisayarlı Tomografi Bulgularının Klinik ve Laboratuvar Verileri Açısından Karşılaştırılması

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ABSTRACT

Aim: *There has been an overload in the workload of intensive care units in the hospitals due the Coronavirus disease 2019 (COVID-19) pandemic, which started in 2019 and caused significant changes in the lives of people. In this process, it is not always easy to distinguish whether the patients followed in the intensive care unit with the suspicion of COVID-19 disease are actually infected or not. Our aim in this study was to reveal possible clinical, laboratory and computed tomography findings between polymerase chain reaction (PCR) (+) and PCR (-) patient groups followed up in the intensive care unit with a preliminary diagnosis of COVID-19.*

Material and Method: *In this study, we evaluated 83 patients who were confirmed to have COVID-19 by reverse transcription polymerase chain reaction (RT-PCR) and 80 patients who were RT-PCR negative but clinically and radiologically suspicious for COVID-19. The CT results of the patients were classified in accordance with the categories specified by the Radiological Society of North America (RSNA). Many laboratory values, clinical progress of the disease, the source of infection and the complaints were also documented. We performed a statistical analysis of the data obtained between the two patient groups.*

Results: *The typical radiological appearance was significantly higher in the positive group while the atypical appearance was significantly higher in the suspected group (p = 0.001). There was no significant difference between the two groups in the indeterminate and negative categories. Regarding the laboratory findings, the means of the Sequential Organ Failure Assessment (SOFA) score, d-dimer, neutrophil, white blood cell, platelet, neutrophile/lymphocyte ratio (NLR) were significantly lower in the RT-PCR positive group. There was no significant difference between the two groups in terms of other laboratory findings.*

Conclusion: *In conclusion, it was determined that it was hard to distinguish the difference between these patients but there may be some clinical, laboratory and CT results that can facilitate this process.*

Key words: *COVID-19; computed tomography; intensive care unit; RT-PCR*

ÖZET

Amaç: *2019 yılında başlayan ve kısa sürede hayatımızda köklü değişikliklere neden olan Coronavirus hastalığı (COVID-19) küresel salgını, hastanelerin yoğun bakım ünitelerine de aşırı iş yükü oluşturmuştur. Bu süreçte COVID-19 hastalığı şüphesiyle yoğun bakım ünitesinde takip edilen hastaların gerçekte enfekte olup olmadığının ayrımı her zaman kolay olmamaktadır. Bu çalışmadaki amacımız, yoğun bakımda COVID-19 ön tanısıyla takip edilen PCR (+) ve PCR (-) hasta grupları arasındaki olası klinik, laboratuvar ve bilgisayarlı tomografi bulgularını ortaya koymaktı.*

Materyal ve Metot: *COVID-19 olduğu ters transkriptaz polimeraz zincir reaksiyonu (RT-PCR) ile doğrulanmış 83 hasta ile RT-PCR negatif olan, ancak klinik ve radyolojik olarak COVID-19 açısından şüpheli 80 hastayı değerlendirdik. Hastaların BT bulgularını Kuzey Amerika Radyoloji Derneği (RSNA) kategorilerine uygun olarak sınıfladık. Ayrıca birçok laboratuvar değerini, klinik olarak hastalık seyrini, bulaş kaynağını ve şikayetlerini dökümante ettik. İki hasta grubu arasında, elde edilen verilerin istatistiksel analizini gerçekleştirdik.*

Bulgular: *Tipik radyolojik görünüm, pozitif grupta anlamlı olarak daha yüksekti, şüpheli grupta ise atipik görünüm anlamlı olarak daha yüksekti (p = 0.001). Belirsiz ve negatif kategorilerde iki grup arasında anlamlı bir fark yoktu. Laboratuvar bulgularına göre, ardışık organ yetmezliği değerlendirmesi (SOFA) skoru, d-dimer, nötrofil, beyaz küre, trombosit, nötrofil/lenfosit oranı (NLR) ortalamaları RT-PCR pozitif grupta anlamlı derecede düşüktü. Diğer laboratuvar bulguları açısından iki grup arasında anlamlı fark yoktu.*

Sonuç: *Sonuç olarak bu iki hasta grubunun ayrımının güç olabileceği fakat bize yardımcı olabilecek bazı klinik, laboratuar ve BT bulgularının olabileceğini tespit ettik.*

Anahtar kelimeler: *COVID-19; bilgisayarlı tomografi; yoğun bakım ünitesi; RT-PCR*

Introduction

Clinical, laboratory, and reverse transcription polymerase chain reaction (RT-PCR) tests are used in the first stage of the diagnosis of Coronavirus disease 2019 (COVID-19), but making the diagnosis becomes very difficult when cases are tested negative in RT-PCR test. In these situations, thorax computed tomography (CT) is used to help to make the diagnosis. In addition, it has been suggested that the sensitivity of thorax CT is higher than RT-PCR (98% vs 71%) in terms of the severity and prevalence of involvement in severe cases[1]. While peripheral, bilateral (multilobar) frosted-glass opacities (consolidation and crazy paving appearance can also accompany) can typically be seen in thorax CT, multifocal round frosted-glass opacities (consolidation and crazy paving appearance can also accompany) as well as other signs of inverted or organized pneumonia can be seen[2,3].

Many studies on COVID-19 disease have focused on the prognosis of laboratory tests such as C-reactive protein (CRP), d-dimer, neutrophil/lymphocyte ratio (NLR) and thoracic CT images until now. For example, Colombi et al. found a significant relationship between a well-ventilated lung volume and intensive care need and death in COVID-19[4]. The aim of this study was to evaluate the differences between the patients with RT-PCR positive and negative results in terms of certain characteristics. Thus, the researchers tried to understand how to use the data in hand to distinguish the suspected patients for COVID-19 pneumonia in services such as intensive care units where complicated patients receive treatment.

Material and Method

Patient Criteria

After obtaining the approval of Ankara City Hospital Ethics Committee (ethics committee number: E1-20-979), 83 patients with positive RT-PCR samples and 80 patients with negative RT-PCR samples and who were monitored for more than 24 hours in Ankara City Hospital Neurology-Orthopedic Hospital Intensive Care Unit between March 27 and June 1, 2020, were included in this study. Patients were divided into two groups as mild and severe: Mild cases were determined to have a respiratory rate of <30/min; peripheral oxygen saturation (SpO_2) > 93%; PaO_2/FiO_2 ratio ≥300 mmHg while severe cases were determined to have a respiratory rate of ≥30/min, SpO_2 ≤ 93%, PaO_2/FiO_2 ratio <300 mmHg.

The patient files were evaluated in terms of clinical and demographic features such as age, sex, comorbidity status, the clinic they were accepted to, mechanic ventilator usage, and the patient's laboratory values such as CRP, procalcitonin, d-dimer and thorax CT image features were recorded. RT-PCR positive cases were named as positive while RT-PCR negative cases were defined as suspected cases. It was checked whether there was a significant difference between the two groups in terms of the abovementioned values.

CT Inspections and Imaging Evaluation

CT scans were evaluated by two radiologists with 10 and 12 years of experience in thoracic CT. The imaging technique was standard for all patients, and non-contrast thorax CT was performed in the suspicion of COVID-19 pneumonia. The images were taken with GE Healthcare (USA) brand GE 128 revolution evo model multi-section CT device during the inspiration phase in the supine position. Imaging parameters were 1.3 mm collimation and 2.5 mm interval,100-120kV tube voltage 130-200 mAs, 240 mA, 1.4 pitch in the 64-section CT device. The section thickness after the reformat was 2.5mm. Thorax CT findings of the patients were defined as four groups as suggested by the Radiological Society of North America (RSNA) Expert Consensus in this study[5]:

Typical Appearance (Cov19Typ): Filling samples (± consolidation) in ground glass opacity with bilateral and peripheral intralobular lines that can accompany.

Indeterminate Appearance (Cov19Ind): Non-rounded and non-peripheral, multifocal, widespread, or one-sided ground glass opacities with no typical findings, no specific distribution.

Atypical Appearance (Cov19Aty): Isolated lobar or segmental consolidation, centrinodular nodules, cavitation, septal thickening without ground glass opacity with the absence of typical or indeterminate results.

Negative for Pneumonia (Cov19Neg): There are no CT results suggesting pneumonia.

In addition to these appearances, radiological findings (ground-glass opacities, consolidation, air bronchogram, pleural effusion, inverted halo signs)(and the distribution of findings in the lungs (unilateral, bilateral, upper lobe, middle lobe, lower lobe, peripheral, diffuse, random ecliptic) were documented and the differences between positive and suspected cases were evaluated. The thorax CT findings (such as cardiomegaly, pleural-pericardial effusion, mediastinal lymphadenopathy) apart from the lungs were also recorded.

Statistical Analysis

Descriptive statistics of the data obtained were calculated as the arithmetic mean, standard deviation (SD), median value, first (25th) and third quartile (75th) (IQR = 75th - 25th), absolute and relative frequencies depending on the type and distribution

of the characteristics and were summarized in tables. The conformity of numerical features to normal distribution was examined by Kolmogorov-Smirnov test.. The relationships between the patients' categorical characteristics, findings and their suspected and positive results were examined by Pearson Chi-Square test or the Fisher-Freeman-Halton exact test. The numerical features of patients with suspected and positive results were compared using Mann-Whitney U test. The statistical significance level was P <0.05 and the SPSS (v.25) program was used in calculations.

Results

A total of 163 COVID-19 patients hospitalized in the intensive care were included in the study. Of these patients, 80 were RT-PCR negative cases and 83 were RT-PCR positive cases. The mean age of the RT-PCR positive patients was 67 ± 13 years, while the mean age of RT-PCR negative patients was 69 ± 15 years. The duration of hospital stay was 11±9 days in both groups. It was found that the male population was higher in both groups (Table 1).

While suspected patients were not in the risk group at their admission, it was observed that the positive patients had a significantly higher rate of overseas, umrah and contact histories (p=0.001).

Regarding the laboratory findings, the means of the Sequential Organ Failure Assessment (SOFA) score, d-dimer, neutrophil, white blood cell, thrombocyte, NLR were significantly lower in the RT-PCR positive group. There was no significant difference between the two groups in terms of other laboratory findings (Table 2).

In the evaluation of the radiological images, the typical radiological appearance was significantly higher in the positive group while the atypical appearance was significantly higher in the suspected group (p = 0.001). There was no significant difference between the two groups in the indeterminate and negative categories. Common findings in COVID-19 pneumonia, such as ground glass appearance and crazy paving appearance were significantly higher in positive cases as predicted (p=0.01). Only the incidence rate of consolidation field was higher in suspected cases (p=0.005) (Table 3).

Regarding the type of involvement, it was found that diffuse or converging involvements were higher among RT-PCR positive cases, and other forms of involvements (such as lobar, segmental, etc.) were statistically

Table 1. Contact history and pre-intensive care follow-up places in cases

Variables	Group	N	%	p	Mean ± SD
Age					
	Suspicious	80	49.07	0.306	69.34±15
	Positive	83	50.93		67.67±13
Duration of Hospital Day					
	Suspicious	80	49.07	0.587	11.01±9
	Positive	83	50.93		11.84±9
Sex					
Male	Suspicious	49	47.6	0.614	
	Positive	54	52.4		
Female	Suspicious	31	51.7		
	Positive	29	48.3		
Contact History					
No Risk	Suspicious	65	63.1	0.001	
	Positive	38	36.9		
Risk Overseas History	Suspicious	1	33.3		
	Positive	2	66.7		
Risk: Umrah History	Suspicious	6	46.2		
	Positive	7	53.8		
Risk: Contact History	Suspicious	8	18.2		
	Positive	36	81.8		
Pre-intensive care follow-up places					
Admission to Hospital: Emergency	Suspicious	62	54.9	0.023	
	Positive	51	45.1		
Admission to Hospital: Service	Suspicious	10	28.6		
	Positive	25	71.4		
Admission to Hospital: Outer center	Suspicious	8	53.3		
	Positive	7	46.7		

found to be accompanying the RT-PCR negative cases more (p=0.001). Considering the evaluation of axial ecliptic, the incidence rate of diffuse involvement accompanied by the whole lung section involvement, was statistically significant in positive cases (p=0.009). In the lateralization category where the distribution of the lesions in both lungs was evaluated, it was found that unilateral lesions were significantly higher in suspected cases while bilateral lesions were significantly higher in positive cases (p=0.04) (Table 3).

While 60% of the positive cases were severe cases, 53% of the suspected patients were severe cases. No statistically significant difference was found in this respect. Regarding the exitus rate between the two groups, there were no statistically significant difference (Table 4).

Table 2. *Laboratory data of suspicious and positive cases*

	Group	N	Mean	SD	Percentiles 25	Percentiles Median	Percentiles 75	P
APACHE Score	Suspicious	80	15.03	9.18	7.25	14.00	20.00	0.215
	Positive	83	13.22	8.30	7.00	10.00	20.00	
SOFA Score	Suspicious	80	6.20	4.09	2.00	6.00	9.00	**0.024**
	Positive	83	4.78	3.15	2.00	4.00	7.00	
Ferritin	Suspicious	75	774.11	1529.18	100.00	348.00	773.00	0.441
	Positive	83	967.66	4161.58	216.00	433.00	688.00	
C-Reactive Protein	Suspicious	80	107.46	82.03	41.50	96.50	162.00	0.904
	Positive	83	105.75	79.56	38.00	98.00	163.00	
Procalcitonin	Suspicious	80	3.50	11.61	0.08	0.27	1.16	0.065
	Positive	83	1.52	8.59	0.08	0.14	0.49	
Sedimentation	Suspicious	77	53.09	37.07	21.00	50.00	83.50	0.288
	Positive	83	57.82	33.52	30.00	55.00	84.00	
Lactate	Suspicious	80	2.40	2.07	1.39	1.78	2.40	0.165
	Positive	83	1.91	1.02	1.25	1.56	2.25	
D-dimer	Suspicious	79	6.31	8.57	1.39	2.42	6.44	**0.001**
	Positive	82	3.26	5.91	0.80	1.28	2.54	
Interleukin-6	Suspicious	63	137.89	234.91	32.00	59.70	141.00	0.157
	Positive	67	113.92	218.37	26.00	50.50	91.00	
Troponin	Suspicious	78	258.68	917.26	7.75	21.00	58.25	0.100
	Positive	82	102.45	280.09	7.00	13.50	34.75	
LDH	Suspicious	80	377.89	249.45	236.50	317.50	447.50	0.176
	Positive	83	381.17	155.06	247.00	354.00	510.00	
ALT	Suspicious	80	46.13	80.62	13.00	22.50	38.75	0.234
	Positive	83	51.10	90.00	17.00	26.00	46.00	
AST	Suspicious	80	61.81	123.27	18.00	31.50	60.00	0.161
	Positive	83	59.75	76.37	22.00	40.00	72.00	
Na	Suspicious	80	138.18	6.91	135.00	138.00	141.75	0.703
	Positive	83	138.10	5.47	135.00	138.00	140.00	
Glucose	Suspicious	80	163.50	120.70	94.75	130.50	176.00	0.681
	Positive	83	140.57	62.49	98.00	120.00	164.00	
Albumin	Suspicious	80	37.66	5.41	35.00	38.00	41.00	0.821
	Positive	83	37.61	5.37	35.00	38.00	41.00	
Lmphocyte	Suspicious	80	1.13	1.30	0.59	0.86	1.27	0.198
	Positive	83	0.89	0.55	0.52	0.80	1.10	
Neutrophil	Suspicious	80	12.23	15.80	5.70	8.83	12.10	**0.001**
	Positive	83	6.95	6.89	3.50	4.79	8.07	
WBC	Suspicious	80	12.67	10.04	7.82	10.40	14.20	**0.001**
	Positive	83	8.39	7.25	4.60	6.10	9.94	
Platelet	Suspicious	80	272.89	132.13	166.00	264.50	349.25	**0.017**
	Positive	83	225.78	93.69	158.00	221.00	279.00	
N/L ratio	Suspicious	80	14.50	16.18	5.22	9.42	18.55	**0.046**
	Positive	83	11.06	14.91	4.30	7.50	12.00	
Urea	Suspicious	80	75.01	61.37	36.25	48.00	88.50	0.150
	Positive	82	54.83	36.44	34.00	43.00	63.00	
Creatinine	Suspicious	80	1.83	2.16	0.77	1.04	1.72	0.165
	Positive	83	1.25	1.41	0.78	0.93	1.25	
GFR	Suspicious	80	62.46	35.34	29.50	65.50	89.50	**0.050**
	Positive	83	73.84	30.47	52.00	77.00	95.00	

*APACHE: Acute Physiology and Chronic Health Evaluation, SOFA: Sequential Organ Failure Assessment, LDH: Lactate dehydrogenase, ALT: Alanin aminotransferaz, AST: Aspartate aminotransferase, WBC: White blood count, N/L ratio: Netrophile/Lymphocyte ratio, GFR: Glomerular filtration rate.

Considering the complications, there were no complications in 98 of 163 patients. The most common complication for the two groups was acute kidney failure. Although the number was higher in suspected cases than positive cases, no statistically significant difference was found between the two groups in this respect (p=0.07) (Table 4).

Regarding the patients' complaints for the application to the hospital, it was observed that the number of patients with the complaints of fever and cough were significantly higher among positive patients (p=0.001).

Discussion

Clinical, laboratory, RT-PCR and thorax CT results are used in the diagnosis of COVID-19 disease in the present day. Despite all these criteria, there may be some patients who are difficult to diagnose, like patients with

Table 3. Distribution of suspected and positive patients according to RSNA classification and radiological findings on thorax CT

		Suspicious n	Suspicious %	Positive n	Positive %	P
RSNA category	Typical	26	31.0	58	69.0	**0.001**
	Indeterminate	10	58.8	7	41.2	
	Atypical	35	77.8	10	22.2	
	Negative	9	52.9	8	47.1	
Ground glass opacity	No finding	33	63.5	19	36.5	**0.012**
	Finding	47	42.3	64	57.7	
Crazy paving pattern	No finding	44	60.3	29	39.7	**0.010**
	Finding	36	40.0	54	60.0	
Consolidation	No finding	53	54.1	45	45.9	0.117
	Finding	27	41.5	38	58.5	
Only consolidation	No finding	56	43.4	73	56.6	**0.005**
	Finding	24	70.6	10	29.4	
Reversed halo sign	No finding	80	49.7	81	50.3	0.162
	Finding	0	0.0	2	100.0	
Subpleural reticulation	No finding	38	50.7	37	49.3	0.708
	Finding	42	47.7	46	52.3	
Pleural effusion	No finding	41	47.7	45	52.3	0.704
	Finding	39	50.6	38	49.4	
Mode of involvement	No finding	10	50.0	10	50.0	**0.001**
	Scattered multiple round	8	57.1	6	42.9	
	Scattered multiple unround	15	50.0	15	50.0	
	Diffuse compound	25	34.2	48	65.8	
	Other (lobar-segmental)	22	84.6	4	15.4	
Axial involvement	No finding	9	45.0	11	55.0	**0.009**
	Peripheral	37	54.4	31	45.6	
	Diffuse	20	35.1	37	64.9	
	Central	7	63.6	4	36.4	
	Other	7	100.0	0	0.0	
Air bronchogram	No finding	53	49.1	55	50.9	0.998
	Finding	27	49.1	28	50.9	
Lateral involvement	No finding	9	52.9	8	47.1	**0.047**
	Unilateral	16	72.7	6	27.3	
	Bilateral	55	44.4	69	55.6	
Lobar involvement	No finding	8	50.0	8	50.0	0.078
	Upper lob	12	75.0	4	25.0	
	Middle lob	0	0.0	1	100.0	
	Lower lob	11	64.7	6	35.3	
	All lobes	49	43.4	64	56.6	
Additional findings	No finding	41	51.3	39	48.8	0.864
	Lymphadenopathy	7	53.8	6	46.2	
	Cardiomegaly	21	50.0	21	50.0	
	Pericardial effusion	0	0.0	2	100.0	
	Emphysema	4	36.4	7	63.6	
	Mass	1	33.3	2	66.7	
	Fibrosis	4	50.0	4	50.0	
	Lymphadenopathy + pneumothorax	2	50.0	2	50.0	

*RSNA: Radiological Society of North America, CT: Computed Tomography.

many additional problems and comorbid conditions, especially those hospitalized in intensive care units. Thorax CT appearances stand out especially in the RT-PCR negative patients with clinical and laboratory results referred to COVID-19 infection. The following questions come to mind at this stage; Is there a serious difference in thorax CT appearances of patients who are tested positive and negative for RT-PCR? Is there a thorax CT appearance or a laboratory or clinical feature that can provide specificity and sensitivity in the diagnosis of COVID-19 for RT-PCR negative patients? Can the diagnosis process be made easier for these patients? It is known that many studies were and are still conducted to answer these questions.

Table 4. *Complaint, comorbidity, treatment, and clinical progress data of the cases*

			Group				
			suspicious		positive		
			n	%	n	%	P
	Additional Germ Reproduction	No finding	53	51.0	51	49.0	0.523
		Finding	27	45.8	32	54.2	
	Clinical Condition	Mild	37	52.9	33	47.1	0.403
		Severe	43	46.2	50	53.8	
	Result	Exitus	34	47.9	37	52.1	0.789
		Discharge	46	50.0	46	50.0	
Treatment	HFN	No finding	76	52.8	68	47.2	**0.009**
		Finding	4	21.1	15	78.9	
	NIMV	No finding	75	50.3	74	49.7	0.295
		Finding	5	35.7	9	64.3	
	IMV	No finding	44	50.0	44	50.0	0.799
		Finding	36	48.0	39	52.0	
	Prone position	No finding	76	52.1	70	47.9	**0.026**
		Finding	4	23.5	13	76.5	
Comorbidity	Diabetes	No finding	51	44.7	63	55.3	0.091
		Finding	29	59.2	20	40.8	
	Hypertension	No finding	45	53.6	39	46.4	0.265
		Finding	35	44.3	44	55.7	
	Cononary Artery Disease	No finding	54	46.6	62	53.4	0.310
		Finding	26	55.3	21	44.7	
	Chronic Obstructive Pulmonary Disease	No finding	65	47.4	72	52.6	0.338
		Finding	15	57.7	11	42.3	
	Chronic Renal Failure	No finding	63	46.0	74	54.0	0.070
		Finding	17	65.4	9	34.6	
	Cancer	No finding	64	46.4	74	53.6	0.105
		Finding	16	64.0	9	36.0	
	Neurological Deficit	No finding	58	46.4	67	53.6	0.215
		Finding	22	57.9	16	42.1	
Patient Complaint	Fever	No finding	56	60.2	37	39.8	**0.001**
		Finding	24	34.3	46	65.7	
	Dyspnea	No finding	31	47.0	35	53.0	0.552
		Finding	49	50.5	48	49.5	
	Cough	No finding	54	55.7	43	44.3	**0.041**
		Finding	26	39.4	40	60.6	
	Diarrhea	No finding	79	48.8	83	51.2	0.307
		Finding	1	100.0	0	0.0	
	Weakness	No finding	58	46.4	67	53.6	0.215
		Finding	22	57.9	16	42.1	
	Nausea	No finding	72	47.7	79	52.3	0.205
		Finding	8	66.7	4	33.3	
	Anorexia	No finding	71	47.0	80	53.0	0.062
		Finding	9	75.0	3	25.0	
	Abdominal pain	No finding	78	48.8	82	51.3	0.539
		Finding	2	66.7	1	33.3	
	Complication	No finding	42	42.9	56	57.1	0.075
		Acute kidney failure	30	57.7	22	42.3	
		Multiorgan failure	3	100.0	0	0.0	
		Pneumotorax	1	50	1	50	
		Thrombosis	4	66.7	2	33.3	

*HFNO: High flow nasal oxygen, NIMV: Non-invasive mechanical ventilation, IMV: Invasive mechanical ventilation.

Whether patients have typical symptoms and the incidence frequency of the disease within society are the determinants for the diagnostic accuracy rates of CT in COVID-19 pneumonia. In a published case report, a 34-year-old male patient from a high-risk area applied to the hospital with a complaint of fever. While his CRP value was high, the other laboratory tests were considered normal. The nasopharyngeal RT-PCR sample taken from the patient was tested negative for four times. Irregular ground-glass opacity was observed in the patients' thorax CT scan taken as he was a suspected case, and the patient was diagnosed with COVID-19[6]. In a study conducted as if to confirm this case, the sensitivity of thoracic CT was calculated to be 90–94%, specificity was 79–84%, positive predictive value was 90%, and negative predictive value was 50–73% in patients with typical clinical findings and in the pandemic period when the prevalence is high[7]. At this point, it should be emphasized that there are studies in the literature showing that CT performed in the prone position shows more accurate results than CT performed in the supine position in patients with comorbidities[8].

In a study conducted in China, 1014 COVID-19 patients were evaluated according to their RT-PCR negative and positive results and thorax CT appearances. Of the 1014 patients, 601 (59%) were evaluated as positive with RT-PCR, and 888 (88%) were evaluated as positive by thorax CT appearances. Thorax CT appearances of 308 (75%) of the patients who were RT-PCR negative were found to be compatible with COVID-19 disease. The sensitivity of thorax CT appearances for diagnosis was found to be 97% in the study[9]. The thorax CT appearances of 26 (32%) of 80 RT-PCR negative patients were evaluated as typical in the present study. However, it must be remembered that the CT appearances of COVID-19 infection can occur due to suspected (indeterminate category) and atypical findings and even without any findings (negative category) as stated in the classification of RSNA. Therefore, the findings listed as typical for CT are not specific to COVID-19 and can be observed in many infective processes and even in noninfectious processes.

In another cohort study, 205 patients with other viral causes and 219 patients diagnosed with COVID-19 disease were compared. It was found that thorax CT appearances were more determinant than RT-PCR test to exclude COVID-19 disease. It was found that COVID-19 pneumonia was more likely to show the peripheral distribution and ground-glass opacity while thin reticular opacity, vascular enlargement, accompanying pleural effusion and lymphadenopathy were found to be less likely to be seen in the same study10. While the typical radiological appearance, especially grounded glass appearance and crazy paving appearance, was significant in positive patients, only consolidation appearance and atypical findings were statistically significant in suspicious cases in this study. These findings are consistent with previous studies, and the peripheral - diffuse distributed grounded glass opacity areas accompanied by crazy paving appearance, which sometimes forms nodular clumps and are described for COVID-19 infection, were the common CT findings obtained among the patients tested positive in the PCR test. The involvement in positive cases showing diffuse-fusion tendency was significant while lobar and segmental involvements were more significant in suspected cases. Considering the axial involvement, the diffuse involvement which spread to the whole lung area was statistically more significant in positive cases while central and other involvements were statistically more significant in suspected cases. In the evaluation of lesions distributed in the lungs, unilateral lesions were significant in suspected cases while bilateral lesions were significant in positive cases. Bilateral involvement was found to be higher in patients tested positive for COVID-19 with the PCR test in this study in line with the literature.

The thorax CT images such as lymphadenopathy, cardiomegaly, pleural effusion, pericardial effusion, emphysema, mass, and fibrosis were examined as additional findings. The most common findings in both groups were cardiomegaly and pleural effusion. The findings of the suspected and positive patients were examined one by one, and no significant difference was found. The reason for this might be that the study group included patients who were monitored in the intensive care unit and who had many additional problems and comorbid conditions. The cavitary lesion that developed in a patient followed up in the intensive care unit reminded us that we should be ready for all kinds of surprises in such patients (Fig. 1).

In another study, the characteristics of the patients who were first tested negative with RT-PCR but tested positive in the control. The probability of having a negative RT-PCR result was found to be statistically significant in patients with a thrombocyte count of more than 207×10^3 mm³ and white blood cell count of more than 6.95×10^3 mm³. In the same study, it was found that patients with negative RT-PCR test result at first had higher inflammation markers in the 6-day period after the onset of the symptoms than the positive cases[11]. The present study discussed the patients who were tested negative in the first RT-PCR test and were diagnosed with COVID-19 disease based on other diagnostic criteria and treated. Additionally, the RT-PCR results of these patients during follow-up were not recorded. In correlation with the current study, blood cell count and thrombocyte count were found to be lower in the RT-PCR positive group while the mean SOFA score, d-dimer, neutrophil, and N/L ratio means were found to be significantly lower. There was no significant difference between the two groups in terms of other laboratory findings.
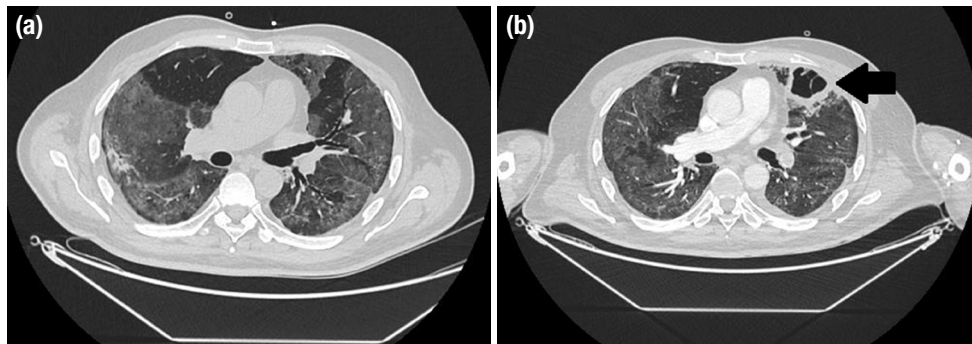
Figure 1. a, b. *A patient who was followed in the intensive care unit due to Covid-19 pneumonia and developed a cavitary lesion in the follow-up CT. Initial **(a)** and approximately one month later CT examination (**b**, arrow).*

Conclusion

The specificity of the thorax CT imaging is very high for COVID-19 disease. However, it should be remembered that typical CT findings defined for COVID-19 are not specific to this disease and COVID-19 infection may manifest in some atypical presentations. The current comorbidities of the patient such as heart failure, kidney failure, immune system problems, chronic destructive lung diseases may affect the lung findings, and these diseases may also cause misunderstandings by creating CT appearances like COVID-19 pneumonia. Despite everything, there will be suspected and undiagnosed patients for COVID-19. The current knowledge on this subject must be deepened by conducting more studies and may be by using sophisticated methods such as artificial intelligence and machine learning.

Conflict of Interest

The authors declare that they have no conflict of interest.

Funding

Ethical Statement

This retrospective study has been approved by the local ethics committee and conducted in accordance with the Declaration of Helsinki (2000).

Acknowledgement

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