Comparison of the Clinical and Radiological Features of COVID-19 and Other Viral Pneumonias

COVID-19 ve Diğer Viral Pnömonilerin Klinik ve Radyolojik Özelliklerinin Karşılaştırılması

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ABSTRACT

Objective: The aim of the study is to compare the differences between COVID-19 pneumonia and other viral pneumonia (OVP) in terms of demographic, clinical and radiological features.

Methods: This retrospective cohort study was conducted in Gazi University Hospital between 11 March and 24 May 2020. Patients, admitted to the hospital with suspected COVID-19 infection aged >18 years and those who had pneumonia on chest computed tomography (CT) scan were evaluated. SARS-CoV-2 RT-PCR and multiplex PCR, for other respiratory viruses, were performed. Patients with a positive SARS-CoV-2 PCR were included in "COVID-19 pneumonia" group and those who had a positive result for any other respiratory viruses and two consecutive negative results for SARS-CoV-2 were included in the "OVP" group. Two groups were compared in terms of clinical, laboratory and chest CT findings.

Results: Of the 63 patients included in the study, 45 had COVID-19 pneumonia and 18 had OVP. Cough, nasal congestion, sputum production and leukocytosis were more common in the OVP group while leukopenia was more common in the COVID-19 pneumonia ($p<0.05$). The distribution pattern of parenchymal lesions on chest CT was more likely to be predominantly peripheral and posterior in COVID-19 pneumonia compared to OVP. Bilateral involvement was also more frequent in COVID-19 group compared to OVP ($p<0.05$).

Conclusion: Distinguishing COVID-19 pneumonia from OVP with clinical and laboratory findings is difficult. Chest CT findings such as peripheral and posterior distribution of the parenchymal lesions and bilateral involvement may help to differentiate COVID-19 pneumonia from OVP.

Key Words: COVID-19, SARS-CoV-2, viral pneumonia, radiological findings, clinical findings, laboratory findings.

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ÖZET

Amaç: Çalışmanın amacı COVID-19 pnömonisi ile diğer viral pnömoniler (OVP) arasındaki farklılıkları demografik, klinik ve radyolojik özellikler açısından karşılaştırmaktır.

Yöntem: Bu retrospektif kohort çalışmaya, COVID-19 enfeksiyonu şüphesiyle hastaneye başvuran ve bilgisayarlı toraks tomografisinde pnömoni bulgusu olan, 18 yaşından büyük hastalar dahil edildi. Tüm hastaların solunum yolu örneklerinde SARS-CoV-2 RT-PCR ve diğer solunum yolu virüsleri için multipleks PCR çalışıldı. SARS-CoV-2 RT-PCR testi pozitif olan hastalar "COVID-19 grubu", multipleks PCR'da herhangi bir solunum yolu virüsü izole edilen ve ardışık 2 SARS-CoV-2 RT-PCR testi negatif gelen hastalar "diğer solunum yolu virüsleri (SYV) grubu" olarak sınıflandırıldı. İki grup klinik özellikler, laboratuvar bulguları ve akciğer tomografisi bulguları açısından karşılaştırıldı.

Bulgular: Çalışmaya alınan 63 hastanın 45'inde COVID pnömonisi, 18'inde SYV'ne bağlı pnömoni saptandı. Öksürük, balgam, nazal konjesyon ve lökositoz SYV grubunda, lökopeni ise COVID-19 grubunda istatistiksel olarak anlamlı düzeyde yüksekti ($p<0.05$). Parankimal lezyonların akciğer tomografisinde dağılım paterni, SYV grubuna kıyasla COVID-19 grubunda daha sıklıkla periferik ve posterior olma eğilimindeydi. COVID-19 grubunda bilateral tutulum SYV grubuna göre daha sıktı ($p<0.05$).

Sonuç: COVID-19 pnömonisini SYV'ne bağlı pnömoniden klinik ve laboratuvar bulguları ile ayırt etmek zordur. Akciğer tomografisinde parankimal lezyonların periferal ve posterior dağılımı ve bilateral tutulum gibi bulgular COVID-19 pnömonisini SYV'ne bağlı pnömoniden ayırt etmeye yardımcı olabilir.

Anahtar Sözcükler: COVID-19, SARS-CoV-2, viral pnömoni, radyolojik bulgular, klinik bulgular, laboratuvar bulguları.

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INTRODUCTION

Coronavirus disease (COVID-19) has affected nearly all countries around the world leading to 65,257,767 cases and 1,513,179 deaths as of December 5, 2020 (1). Although most of the COVID-19 infections are asymptomatic or mildly symptomatic, it can cause pneumonia, acute respiratory failure, and death mostly in elderly patients with comorbid diseases (2).

In recent years, with the widespread use of molecular diagnostic methods, it has been understood that respiratory viruses have an important role in the etiology of community-acquired pneumonia (CAP). In the literature, these viruses, which frequently show seasonal characteristics, were shown in 13.5-56% of the patients with CAP and in 23-36% of the patients with severe pneumonia requiring intensive care admission (3, 4). Similar to COVID-19 pneumonia, viral pneumonia is known to cause severe disease and death in people with advanced age (>65 years) comorbidity and immune deficiency (5).

The period when COVID-19 started in our country and in the northern hemisphere coincides with a time when the respiratory viruses are intensely circulating. The data from the severe acute respiratory infections (SARI) surveillance of 2019 supports this view that the prevalence of respiratory viruses in hospitalized SARI cases in spring varied between 20-60% (6). It is important to differentiate COVID-19 pneumonia from the other viral pneumonias (OVPs) to plan appropriate treatment, isolate patients and take adequate infection control measures. Therefore, clinical and radiological parameters, which will help to distinguish COVID-19 pneumonia from OVPs, are crucial.

The aim of the study is to compare the differences between COVID-19 pneumonia and OVP in terms of demographic, clinical and radiological features.

METHODS

This retrospective cohort study was conducted in Gazi University Hospital between 11 March and 24 May 2020. The study was approved by the Ethical Committee of Gazi University School of Medicine and was conducted according to the Declaration of Helsinki and Good Clinical Practice (22 April 2020, No: 268).

Patient groups and data extraction

Patients, admitted to the hospital with suspected COVID-19 infection aged >18 years and those who had pneumonia on chest computed tomography scan were evaluated retrospectively. SARS-CoV-2 RT-PCR and multiplex PCR, for other respiratory viruses, were performed in nasopharyngeal and oropharyngeal swabs obtained from all patients. If the initial SARS-CoV-2 test was negative, a repeated RT-PCR was performed 24 hours after the first negative result. Patients with a positive SARS-CoV-2 PCR result were included in "COVID-19 pneumonia" group and those who had a positive result for any other respiratory viruses and two consecutive negative results for SARS-CoV-2 were included in the "OVP" group. The data including patient demographics, comorbidities, medications, vital signs, initial laboratory tests and inpatient medications were obtained from electronic medical records.

Suspected cases were diagnosed according to the criteria of COVID-19 national guideline: (a) fever or at least one of the signs and symptoms of acute respiratory disease (cough and dyspnoea), and the clinical condition cannot be explained by another cause/disease, and the history of traveling abroad 14 days before the onset of symptoms (b) fever or at least one of the signs and symptoms of acute respiratory disease (cough and dyspnoea), and close contact to a confirmed COVID-19 patient 14 days before the onset of symptoms (c) fever and at least one of the signs and symptoms of acute respiratory disease (cough and dyspnoea), and hospitalization due to SARI, and the clinical condition cannot be explained by another cause/disease (d) a sudden onset of fever with cough or dyspnoea without rhinorrhea (7). PCR tests were performed in the molecular virology laboratory authorized by Ministry of Health, General Directorate of Public Health. The multiplex PCR kit, used for identifying viruses other than SARS-CoV-2, can detect the following respiratory pathogens: influenza A, H1N1, influenza B, human parainfluenza (1-2-3-4), human rhinovirus, human coronavirus (NL63, 229E, OC43, HKU1), human metapneumovirus A/B, human bocavirus, human respiratory syncytial virus A/B, human adenovirus, human parechovirus, *Mycoplasma pneumoniae* and enterovirus.

Chest CT interpretation

All CT examinations were evaluated by a radiologist with 15 years of experience in thoracic radiology. Parenchymal findings which may be related to pneumonia such as ground glass opacities (GGOs), consolidation, nodule, interstitial pattern, tree in bud appearance, were recorded. In addition, other findings such as pleural effusion, presence of lymphadenopathy (LAP), concomitant bronchiectasis, parenchymal bands and parenchymal distortion were recorded. The distribution pattern of the lesions, bilaterality, upper or lower lobe predominancy, peripheral or central, anterior or posterior weighted involvement features were also noted. All CT scans were assessed and radiological findings of pneumonia were classified as 'typical appearance', 'indeterminate appearance', atypical appearance' and 'negative for pneumonia' on the basis of RSNA Expert Consensus Statement on Reporting Chest CT Findings Related to COVID-19 (8).

Statistical analysis

SPSS software for Windows (version 17, IBM, Armonk, NY) was used to analyze the data. Categorical variables were described as frequency rates and percentages, and continuous variables were described using median and interquartile range (IQR) values. The fitness of the continuous variables to the normal distribution was evaluated with the Kolmogorov Smirnov test. Means for continuous variables were compared using the Mann- Whitney U test as the data were not normally distributed. Proportions for categorical variables were compared using the $\chi 2$ test, although the Fisher exact test was used when the data were limited. A p-value of <.05 was considered statistically significant.

RESULTS

A total of 63 patients were included in the study. Of them 45 (71.4%) was in the COVID-19 and 18 (28.6%) was in the OVP group. The respiratory viruses detected in the OVP group were rhinovirus (n=9, 14.3%), metapneumovirus (n=6, 9.5 %), RSV (n=1, %1.6), parainfluenza (n=1, %1.6) and bocavirus (n=1, %1.6).

Baseline characteristics of patients with COVID-19 pneumonia and OVP were shown in Table 1. Two groups were similar in terms of demographics, comorbidities and home medications with an exception that malignancy was more prevalent in the OVP group ($p<0.05$). The rate of patients presenting with cough, nasal congestion and sputum production were higher in the OVP group compared to COVID-19 ($p<0.05$). Leukocytosis was more common in the OVP group while leukopenia was more common in the COVID-19 group ($p<0.05$).

Table 1: Baseline characteristics of patients with COVID-19 pneumonia and OVP.

	COVID-19 pneumonia, n=45 (%)	OVP, n=18 (%)	*P* value
Age, median (IQR)	54 (43.5-70)	55.5 (30.7-64.5)	0.226
Sex, female	18 (40)	7 (38.9)	0.935
Comorbidities			
Hypertension	17 (37.8)	3 (16.7)	0.091
Cardiovasculary disease	5 (11.1)	2 (11.1)	1.000
Diabetes mellitus	6 (13.3)	2(11.1)	0.809
Chronic obstructive pulmonary disease	2 (4.4)	2 (11.1)	0.350
Asthma	5 (11.1)	4 (22.2)	0.262
Malignacy	3 (6.7)	6 (33.3)	**0.01**
Active smooker	13 (28.9)	8 (44.4)	0.237
Patients with ≥1 comorbidities	23 (51.1)	13 (72.2)	0.126
Patients with ≥2 comorbidities	10 (22.2)	4 (22.2)	1.000
Home drugs			
Angiotensin converting enzyme inhibitors/ angiotensin receptor blockers	12 (26.7)	2 (11.1)	0.158
Non-steroidal anti-inflammatory drugs	1 (2.2)	0	0.410
Statins	2 (4.4)	0	0.241
Immunsupressive drugs	3 (6.7)	4 (22.2)	0.092
Clinical features			
Fever	18 (40)	9 (50)	0.469
Cough	19 (42.4)	16 (88.9)	**<0.001**
Sore throat	7 (15.6)	3 (16.7)	0.914
Nasal congestion	3 (6.7)	5(27.8)	**0.031**
Myalgia or fatigue	15 (33.3)	3 (16.7)	0.171
Sputum production	5 (11.1)	7 (38.9)	**0.011**
Headache	7 (15.6)	4 (22.2)	0.536
Shortness of breath	20 (44.4)	12 (66.7)	0.111
Diarrhea	3 (6.7)	1 (5.6)	N/A
O_2 saturation < 90% or oxygen support at admission	8(17.8)	6 (33.3)	0.191
Laboratory results			
WBC ($10^3/\mu L$)			
>11,000 /µL	2 (4.4)	8 (44.4)	**0.001**
<4,000 /µL	23 (51.1)	5 (27.8)	**0.0087**
Lymphocyte <1,000 /µL	17(37.8)	7(38.9)	0.935
HB* <13 g/dl (male), <12 g/dl (female)	17(37.8)	6(33.3)	0.740
Platelet <150,000 /µL	6(13.3)	4(22.2)	0.395
ALT* >50 U/L	9 (20)	3(16.7)	0.758
AST* >50 U/L	5(11.1)	2(11.1)	1.000
Creatinine >1.1 mg/dl	7(15.6)	1(5.6)	0.248
CRP* >5 mg/L	38 (84.4)	18 (100)	0.177
Procalcitonin >0.5 ng/ml	2(4.4)	1(5.6)	0.854
Troponin*, ng/L (median, IQR)	7 (5-14.5)	6.7(5-13.2)	0.962
LDH* >248 U/L	28(62.2)	6(33.3)	**0.038**
INR* > 1.2	8(17.8)	4(22.2)	0.688
D-dimer > 0.5 µg/mL	26(57.8)	15(83.3)	0.055
Fibrinogen >400 mg/dL	30(66.7)	16(88.9)	0.057
Creatine kinase >171 U/L	15(33.3)	3(16.7)	0.171
Ferritin, >336 ng/mL	12(26.7)	16(88.9)	**<0.001**
Lactate, mMol/L (median, IQR)	1.3 (1.05-1.7)	1.7 (1.3-1.8)	0.051

WBC: White blood cell, Hb: Hemoglobin, ALT: Alanin aminotranspherase, AST: Aspartate aminotransferase, CRP: C-reactive protein, Troponin: High sensitive troponin T, LDH: Lactate dehydrogenase, International normalized *ratio* (INR), N/A: Not applicable

Chest CT findings of patients with COVID-19 pneumonia and OVP were shown in Table 2. The most common finding of pneumonia in both groups was ground glass opacity. When compared in terms of imaging features, the rate of GGOs did not differ in both groups while consolidation was more prevalent in the OVP group (p<0.05).

The distribution pattern of parenchymal lesions on chest CT was more likely to be predominantly peripheral and posterior in COVID-19 pneumonia. Also compared to OVP, bilateral involvement was more frequent than unilateral involvement in COVID-19 group (p<0.05). Two transverse thin-section CT scans in patients with COVID-19 pneumonia and rhinovirus pneumonia are shown in Fig. 1 and 2.

Table 2: Chest CT findings of patients with COVID-19 pneumonia and OVP.

	COVID-19 pneumonia, n= 45(%)	OVP, n=18(%)	*P* value
Symptom duration before chest CT (median, IQR)	3 (2-7)	4 (3-7)	0.247
Bilateral involvement	39 (86.7)	10 (55.6)	**0.007**
Imaging features (radiologic pattern)			
GGO	40(88.9)	13(72.2)	0.102
GGO and consolidation	17(37.8)	9(50)	0.373
Consolidation	11(24.4)	9(50)	**0.049**
Reverse halo sign	4(8.9)	1(5.6)	0.648
Crazy paving	22(48.9)	7(38.9)	0.472
Tree in bud	0(0)	5(27.8)	N/A*
Bronchiectasis/bronchial wall thickening	6(13.3)	5(27.8)	0.172
Pleural effusion	4(8.9)	3(16.7)	0.391
Lymphadenopathy	1(2.2)	0	0.410
Cavitation	0	1(5.6)	N/A*
Distribution			
Peripheral	36(80)	7(38.9)	**0.004**
Posterior	27(60)	3(16.7)	**0.004**
Lower lobes	27(60)	7(38.9)	0.155
CT interpretation for COVID-19 pneumonia			**0.001**
Atypical	3(6.7)	9(50)	
İndeterminate	8(17.8)	8(44.4)	
Typical	34(75.6)	1(5.6)	

*N/A: Not applicable

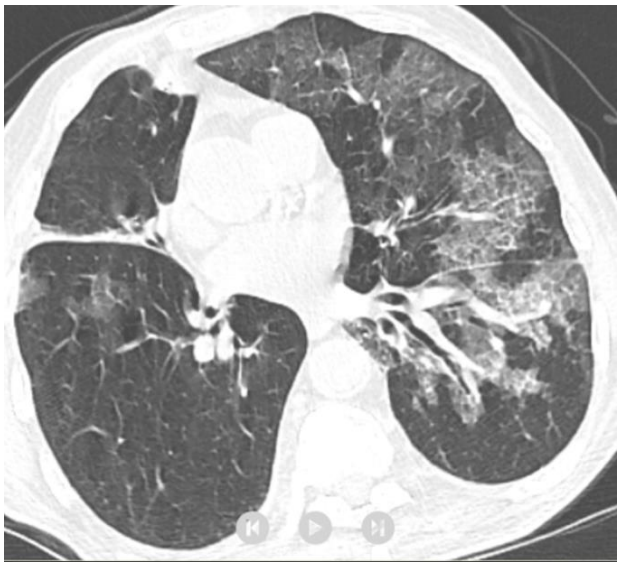

Figure 1: Bilateral GGO and superimposed interlobular septal thickening; crazy paving pattern in a patient with COVID-19 pneumonia

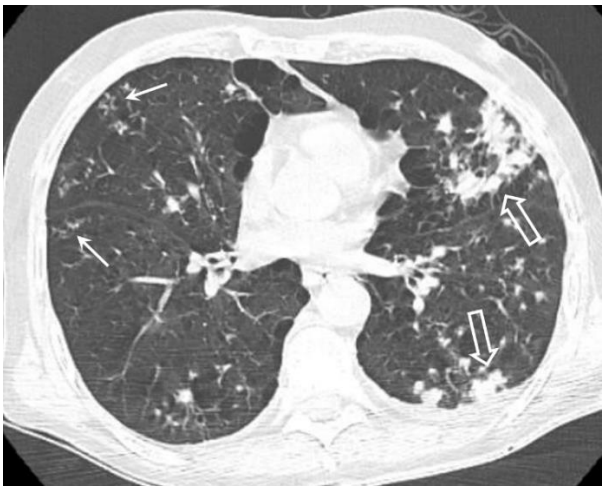

Figure 2: Bilateral peribronchovascular coalescent nodules (hollow arrows) and tree in bud pattern (white solid arrows). Rhinovirus pneumonia

The sensitivity, specificity, positive likelihood ratio, negative likelihood ratio and accuracy of typical chest CT findings according to RSNA criteria (3) in differentiating COVID-19 pneumonia from OVP were 75.5% (95% CI: 60.4-87.1%), 94.4% (72.7-99.8%), 13.6 (2.01-92.2), 0.26 (0.15-0.44) and 80.9 (69.0-89.7) respectively.

DISCUSSION

This study demonstrates that chest CT findings such as the presence of bilateral, posterior and peripherally distributed GGOs can differentiate COVID-19 pneumonia from OVP with a high specificity and *favorable sensitivity* although clinical and laboratory findings are not helpful in this context.

Respiratory viruses are increasingly recognized as a cause of community-acquired pneumonia (CAP) in adults, especially the elderly, and children. Studies have revealed that respiratory viruses like influenza, rhinovirus, RSV, coronavirus, adenovirus, parainfluenza and HMPV were the etiologic agents in 20-25% of CAP cases (9). The most common pathogens in CAP were identified as influenza and rhinovirus in several studies (3). Rhinovirus has long been associated with common cold and their role in pneumonia has been controversial. However, recent evidence supports that rhinovirus can be the cause of lower respiratory tract infections in adults and can lead to severe pneumonia (3, 4). In our study, the detection of rhinovirus in 9 of 18 patients with OVP supports this evidence. Surprisingly, no influenza virus was detected in our study. The reason for this may be the early end of the influenza season due to the protective measures taken regarding SARS-CoV-2 (2). Wu et al., 2020 also reported that the number of influenza cases showed a decreasing trend from the beginning of 2020 in Guangzhou City due to the several measures taken by Chinese government to control SARS-CoV-2 (10).

Respiratory viruses generally present with various and overlapping sign and symptoms which make them difficult to differentiate (11). In our study, shortness of breath, cough and fever were the main symptoms in both groups. When compared to COVID-19, cough, sputum production and nasal congestion were more prevalent in the OVP group ($p< 0.05$). These symptoms were reported in non COVID-19 viral pneumonia and COVID-19 pneumonia with changing frequency in the literature and no symptoms seem to be specific for any viral disease (3, 12). Therefore, it is difficult to predict viral etiology with only clinical symptoms.

The most frequent laboratory abnormalities in COVID-19 patients are lymphopenia, elevated levels of C-reactive protein, lactate dehydrogenase (LDH), D-dimer, creatine kinase, fibrinogen and aminotransferase (13, 14). Many patients with COVID-19 pneumonia have normal or decreased leukocyte count while leukocytosis can be present in 5.9-30% of the cases (13, 14). Leukocytosis, more specifically neutrophilia, has been mainly observed in severe COVID-19 cases and evaluated as a negative prognostic factor for severe disease (15). Patients with OVP were more likely to have a normal leukocyte count as well (12, 16). However, in a pediatric study, the proportion of patients with an increased leukocyte count ($>15.0x10^9$/L) was 47% in community acquired viral pneumonia (9). In another pediatric study, patients with HMPV, influenza A and RSV lower respiratory tract infections had high mean leukocyte counts above $13.0x10^9$/L (17). In our study, the frequency of leukopenia was higher in COVID-19 patients while leukocytosis was more common in the OVP group ($p<0.05$). Bai et al. also found that leukocytosis was significantly frequent in non-COVID-19 viral pneumonia compared to COVID-19 pneumonia similar to our finding (18). In our study, all laboratory findings except leukocyte, ferritin and LDH were similar in both groups. This shows that initial laboratory findings in COVID-19 pneumonia are not reliable to differentiate SARS-CoV-2 from other viral agents.

It is obvious that clinical and laboratory findings have limited contribution in the differential diagnosis of COVID-19 pneumonia. For the confirmed diagnosis, real-time polymerase chain reaction (RT-PCR) of the respiratory tract samples has been used as the gold standard test. However, PCR tests have some disadvantages: it takes long time to reach the results and the test can give false negative results especially in the early course of the disease (19). A rapid diagnostic test is needed for the prompt evaluation and isolation of patients. Imaging modalities, especially chest CT, stands out as an easily accessible and immediate diagnostic method with a high sensitivity up to 97% (20). Despite its high sensitivity, specificity of chest CT is low and is reported as 37% in the literature. Even the most typical findings may overlap with OVPs and noninfectious diseases (21). However, in a recent study, radiologists from China and the United States distinguished COVID-19 from viral pneumonia with high specificity and moderate sensitivity (18). In accordance with this study, we also found that the typical CT findings of COVID-19 pneumonia defined by the RSNA, have high specificity and favorable sensitivity in differentiating COVID-19 pneumonia from OVP.

Recent studies showed that typical chest CT findings of COVID-19 pneumonia included bilateral patchy GGOs or consolidation with peripheral distribution (22, 23). The main features of COVID-19 pneumonia seem to be GGO and less commonly consolidation which are also common imaging findings in OVP [24]. In our study, GGOs (88%), bilateral involvement (86.7%) and peripheral distribution (80%) were the most frequent radiological findings in patients with COVID-19 pneumonia, in accordance with the literature. GGOs were common in both groups and there was no statistical difference. Rather than presence of GGO, the distribution pattern (peripheral and posterior) and bilateral involvement are significant features in differentiating COVID-19 from OVP ($p<0.05$). Based on our data, we think that presence of bilateral, posterior and peripherally distributed GGOs may be helpful in differentiating COVID-19 pneumonia from OVPs.

In conclusion, distinguishing COVID-19 pneumonia from OVP with clinical and laboratory findings is difficult. Nasal congestion, sputum production and leukocytosis were in favor of OVP. Chest CT provides us prompt evaluation and is helpful in differential diagnosis if the patient presents with typical COVID-19 findings. When atypical findings are present, recurrent PCR tests for SARS-CoV-2 and other viral agents should be done to clarify the etiology.

Conflict of interest

No conflict of interest was declared by the authors.

REFERENCES

1. World Health Organization (WHO). WHO Coronavirus Disease (COVID-19) Dashboard [online]. Website: https://covid19.who.int/?gclid=CjwKCAiAn7L-BRBbEiwAl9UtkM-ypxqWQhwdwEjTOOxeeQ6TUr464S9tV6PU-ssnU--xT0DtDsvJ8BoCv84QAvD_BwE [accessed 6 December 2020].
2. Lomoro P, Verde F, Zerboni F, Simonetti I, Borghi C, Fachinetti C et al. COVID-19 pneumonia manifestations at the admission on chest ultrasound, radiographs, and CT: single-center study and comprehensive radiologic literature review. European Journal of Radiology Open 2020; 7: 100231.
3. Jennings LC, Anderson TP, Beynon KA, Chua A, Laing RT, Werno AM et al. Incidence and characteristics of viral community-acquired pneumonia in adults. Thorax 2008;63:42-8.
4. Choi SH, Hong SB, Ko GB, Lee Y, Park HJ, Park SY et al. Viral infection in patients with severe pneumonia requiring intensive care unit admission. American Journal of Respiratory and Critical Care Medicine 2012; 186: 325-32.
5. Kim JE, Kim UJ, Kim HK, Cho SK, An JH, Kang SJ et al. Predictors of viral pneumonia in patients with community-acquired pneumonia. PLoS One 2014; 9: e114710. doi: 10.1371/journal.pone.0114710.
6. European Centre for Disease Prevention and Control (2020). Weekly influenza update, week 16, April 2020. Website https://www.ecdc.europa.eu/en/publications-data/weekly-influenza-update-week-16-april-2020 [accessed 19 July 2020].
7. T.C. Sağlık Bakanlığı (2020). COVID-19 (SARS-CoV-2 enfeksiyonu) rehberi. Website https://covid19bilgi.saglik.gov.tr/tr/covid-19-rehberi.html [accessed 14 May 2020].
8. Simpson S, Kay FU, Abbara S, Bhalla S, Chung JH, Chung M et al. Radiological society of North America expert consensus statement on reporting chest ct findings related to COVID-19. Endorsed by the society of thoracic radiology, the American college of radiology, and RSNA. Journal of Thoracic Imaging 2020; 35 (4): 219-227.
9. Virkki R, Juven T, Rikalainen H, Svedström E, Mertsola J, Ruuskanen O. Differentiation of bacterial and viral pneumonia in children. Thorax 2002; 57: 438-41.
10. Wu D, Lu J, Liu Y, Zhang Z, Luo L. Positive effects of COVID-19 control measures on influenza prevention. International Journal of Infectious Diseases 2020; 95: 345-6.
11. Nichols WG, Peck Campbell AJ, Boeckh M. Respiratory viruses other than influenza virus: impact and therapeutic advances. Clinical Microbiology Reviews 2008; 21: 274-90.
12. Johnstone J, Majumdar SR, Fox JD, Marrie TJ. Viral infection in adults hospitalized with community-acquired pneumonia: prevalence, pathogens, and presentation. Chest 2008; 134: 1141-8.

13. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He J et al. Clinical characteristics of coronavirus disease 2019 in China. New England Journal of Medicine 2020; 382: 1708-20.

14. Jiang F, Deng L, Zhang L, Cai Y, Cheung CW, Xia Z. Review of the clinical characteristics of coronavirus disease 2019 (COVID-19). Journal of General Internal Medicine 2020; 35: 1545-9.

15. Huang G, Kovalic AJ, Graber CJ. Prognostic value of leukocytosis and lymphopenia for coronavirus disease severity. Emerging Infectious Diseases 2020; 26: 1839-41.

16. Angeles Marcos M, Camps M, Pumarola T, Antonio Martinez J, Martinez E, Menso J et al. The role of viruses in the aetiology of community-acquired pneumonia in adults. Antivir Therapy 2006; 11: 351-9.

17. Wolf DG, Greenberg D, Kalkstein D, Shemer-Avni Y, Givon-Lavi N, Saleh N et al. Comparison of human metapneumovirus, respiratory syncytial virus and influenza A virus lower respiratory tract infections in hospitalized young children. The Pediatric Infectious Disease Journal 2006; 25: 320-4.

18. Bai HX, Hsieh B, Xiong Z, Halsey K, Choi JW, Tran TML et al. Performance of radiologists in differentiating COVID-19 from viral pneumonia on chest CT. Radiology 2020; 296: E46-54.

19. Kucirka LM, Lauer SA, Laeyendecker O, Boon D, Lessler J. Variation in false-negative rate of reverse transcriptase polymerase chain reaction-based SARS-CoV-2 tests by time since exposure. Annals of Internal Medicine 2020; M20-1495.

20. Caruso D, Zerunian M, Polici M, Pucciarelli F, Polidori T, Rucci C et al. Chest CT features of COVID-19 in Rome, Italy. Radiology 2020; 296: E79-85.

21. Çinkooğlu A, Hepdurgun C, Bayraktaroğlu S, Ceylan N, Savaş R. CT imaging features of COVID-19 pneum

22. Liu M, Zeng W, Wen Y, Zheng Y, Lv F, Xiao K. COVID-19 pneumonia: CT findings of 122 patients and differentiation from influenza pneumonia. European Radiology 2020; 30: 3563-5469.

23. Li M. Chest CT features and their role in COVID-19. Radiology of Infectious Diseases 2020; 7 (2): 51-54.

24. Koo HJ, Lim S, Choe J, Choi SH, Sung H, Do KH. Radiographic and CT features of viral pneumonia. Radiographics 2018; 38 : 719-39.