RESEARCH ARTICLE / *Araştırma Makalesi*

Can Mortality Be Predicted With Semi-Quantitative Visual Scoring In Coronavirus Disease?

Koronavirus Hastalığında Yarı Kantitatif Görsel Skorlama ile Mortalite Öngörülebilir Mi?

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Abstract

Objective The study was aimed to predict the COVID 19 prognosis using a semi-quantitative scoring method with computed tomography (CT).

Materials and Methods From April 1 to June 25, 2020, 108 symptomatic COVID-19 patients were enrolled and followed up until they were discharged or died. CT scans were reviewed for the patterns and distribution of lung abnormalities, total CT scores and number of lobes involved. A semi-quantitative CT score was calculated based on the extent of lobar involvement (0:0%; 1:5-25%; 2:26-50%; 3:51-75%; 4, 76-100%; range 0-4; global score 0-20). The predictive role of the CT score on the prognosis of the patients was evaluated statistically.

Results The mean global CT score was 7.47±5.18. 12 patient did not show any parenchymal involvement at CT and was therefore scored as 0. Comparisons have been made between lobes for each lung. Regarding the right lung, mean CT score was significantly higher in right lower lobe than in middle lobe (p=0.001) and right upper lobe (p=0.001); mean CT score was significantly higher in right middle lobe than in upper lobe (p=0.001). Concerning the left lung, mean CT score was significantly higher in left lower lobe than in left upper lobe (p =0.001). Mean global CT score of survival group was 5.53±3.94, while mortal group was 9.40±5.57. The score of mortal group was significantly higher than survival group (p=0.001).

Conclusion The imaging features and dynamic changes could provide the most direct evidence for assessing the severity of the disease and the prognosis. Simple scoring method according to CT scans may help triage patients and screening patients who need more aggressive treatment and closely monitoring.

Keywords COVID-19; computed tomography; scoring methods; prognosis

Öz

Amaç *Çalışmamızda Bilgisayarlı tomografi (BT) ile yarı kantitatif bir puanlama yöntemi kullanarak COVID 19 prognozunu tahmin etmeyi amaçladık.*

Gereç ve Yöntemler *1 Nisan - 25 Haziran 2020 arasında 108 semptomatik COVID-19 hastası taburcu olana veya ölene kadar takip edildi. Akciğer anormalliklerinin paternleri ve dağılımı, toplam BT skorları ve tutulan lobların sayısı için BT görüntüleri değerlendirildi. Lober tutulumun kapsamına göre yarı kantitatif BT skoru hesaplandı (0: % 0; 1: % 5-25; 2: % 26-50; 3: % 51-75; 4: %76-100; aralık 0-4; toplam puan 0-20). BT skorunun hastaların prognozu üzerindeki prediktif rolü istatistiksel olarak değerlendirildi.*

Bulgular *Toplam BT skoru ortalama 7.47 ± 5.18'di. 12 hastada BT'de herhangi bir parankimal tutulum görülmedi ve bu nedenle 0 olarak skorlandı. Her akciğer için loblar arasında karşılaştırmalar yapıldı. Sağ akciğerle ilgili olarak, ortalama BT skoru sağ alt lobda orta lobdan (p =0.001) ve üst lobdan (p =0.001) anlamlı olarak yüksekti; ortalama BT skoru sağ orta lobda üst loba göre anlamlı olarak daha yüksekti (p =0.001). Sol akciğerle ilgili olarak ortalama BT skoru sol alt lobda üst lobdan anlamlı olarak yüksekti (p =0.001). Sağ kalanlar grubunun total BT skoru ortalama 5.53 ± 3.94 iken, mortalite grubunda 9.40 ± 5.57 olarak bulundu. Mortalite grubunun skoru sağ kalanlar grubuna göre anlamlı derecede yüksekti (p =0.001).*

Sonuç *Görüntüleme özellikleri ve dinamik değişiklikler, hastalığın ciddiyetini ve prognozunu hesaplamak için doğrudan bilgi sağlayabilir. BT görüntülemeleri ile yapılan basit puanlama yöntemi, hastaların yönlendirilmesine, yakından izlenmeye veya agresif tedaviye ihtiyaç duyan hastaların belirlenmesine yardımcı olabilir.*

Anahtar Kelimeler *COVID-19; bilgisayarlı tomografi; skorlama metodları; prognoz*

INTRODUCTION

The 2019 new coronavirus disease (COVID-19) continues as a pandemic, causing the death of more than 1 million people since December 12, 2020, when it was first seen. Early diagnosis of the disease is very important in terms of both treatment and prevention of its spread.[1,2] Treatment options vary depending on the severity of the patient's condition, and patients with severe and critical cases of COVID-19 have a poor survival prognosis.[3]

Diagnosis of COVID-19 is confirmed by real-time reverse transcription polymerase chain reaction (RT-PCR) test with high specificity but low sensitivity.[3,4] Computed Tomography (CT) is an important alternative to RT-PCR in the rapid diagnosis and monitoring of COVID-19 pneumonia. It has been reported that patients with negative RT-PCR results may have positive chest CT findings, and combining RT-PCR with CT scans is expected to improve the diagnosis of COVID-19.[4] CT imaging features of COVID-19 patients at admission included peripheral and bilateral ground glass opacities (GGO) were also often accompanied by consolidation.[5] A better understanding of the progression of CT findings in COVID-19 pneumonia may help facilitate accurate diagnosis and disease stage.[2] Some studies have estimated the severity of COVID-19 based on CT characteristics or semiquantitative visual CT scores.[5]

The purpose of this retrospective study is to predict short-term mortality with CT-based semi-quantitative scoring method.

MATERIALS and METHODS

This retrospective descriptive study was carried out among 108 patients who were admitted to Sakarya University Education and Research Hospital between 1 April and 25 June 2020 with suspicion of COVID-19. The study protocol was approved by the local ethics committee of Sakarya University, Faculty of Medicine (22/09/2020-E.8423 No:71522473/050.01.04/504).

Patients and Study Design

The data required for this retrospective study were obtained from medical records of the patients in the information system of our hospital. RT-PCR assay of nasopharyngeal swab samples and chest CT imaging data of 108 patients were recorded within the scope of the study. The exclusion criteria were as follows: (1) patients who recently experienced clinically defined pulmonary infection attributable to other pathogens, (2) patients with severe artifacts on CT images, and (3) patients whose age was less than 18 years.

CT Imaging Acquisition

All the patients underwent non-enhanced chest CT examinations for detecting COVID-19 pneumonia in the supine position during end-inspiration. The CT scans of patients were performed with a 64-section multi-detector CT scanner (Aquilion 64, Toshiba, Japan). The protocols were as follows. Tube voltage 120 kV, automatic tube current (120–380) mA, thickness 5 mm, slice interval 5 mm, rotation speed 0.5 s, and helical pitch 1.0875:1 or 1.375:1. The informed consents for CT examination were obtained from all patients or their parents.

CT Visual Quantitative Evaluation

The degree of pulmonary involvement of these abnormalities were evaluated by a semiquantitative scoring system. Percentage of involvement in each lobe was recorded as well as the overall lung "total severity score (TSS)". Each of the five lung lobes was assessed for percentage of the lobar involvement and classified as none (0%), minimal (1–25%), mild (26–50%), moderate (51–75%), or severe (76–100%), with corresponded score as 0, 1, 2, 3 or 4. The TSS was reached by summing the five lobe scores (range from 0 to 20).

The distribution of lung abnormalities was recorded as predominantly subpleural (involving mainly the peripheral one-third of the lung), central (involving mainly the central two-third of the lung), both peripheral and central

or random (without predilection for subpleural or central regions).

Statistical Analysis

Data management and statistical analysis were performed by using the statistical package for social sciences (SPSS) version 18 for Microsoft Windows. After administrating descriptive statistical analyses (frequency, percentage distribution, mean ± standard deviation (SD)), normal distribution of continuous variables was assessed by Shapiro-Wilk and Kolmogorov Smirnov Tests. Chi-square test was conducted in order to evaluate the group difference in terms of discrete variables. Indipendent t-tests were administrated for the ones with continuous variables meeting parametric assumptions. The data obtained were compared by considering the gender difference. Statistical significance was indicated by a p value of less than 0.05.

RESULTS

A total of 108 patients, 51 men (47.2%) and 57 women (52.8%), were included in the study. The average age is 70.83±11.98 years (age range, 34–96 years). Peripheral lesions were more common than central lung lesions. The majority of patients had bilateral lung involvement during the course of the diease. (Table 1)

Pathological involvement was most common in the inferior lobes, right lower lobe (RLL) in 93 patients (86.1%), and left lower lobe (LLL) in 87 patients (80.6%). The mean CT scores were found as follows: 1.26±1.02 for the right upper lobe (RUL), 1.33±1.16 for the middle lobe (ML), 1.87±1.34 for the right lower lobe (RLL), 1.2±0.95 for the left upper lobe (LUL), and 1.79±1.39 for the left lower lobe (LLL) (Table 2). The mean global CT score was 7.47±5.18. 12 patient did not show any parenchymal involvement at CT and was therefore scored as 0. Comparisons have been made between lobes for each lung. Regarding the right lung, mean CT score was significantly higher in RLL than in ML (p= 0.001) and RUL (p=0.001); mean CT score was significantly higher in RML than in UL (p=0.001). Concerning the left lung, mean CT score was significantly higher in LLL than in LUL (p=0.001)

Table 1. CT features in mortality and survival groups.

CT Features	All patients (n=108)	Survival Group (n=54)	Mortality Group (n=54)	p
Predominant distribution				
Peripheral	37(34.3)	23(42.5)	14(25.9)	0,068
Peripheral + Central	31(28.7)	9(16.6)	22(40.7)	0,006*
Random	25(23.1)	13(24)	12(22.2)	0,082
Central	1(0.9)	1(1.8)	0	
Anatomic sides involved				
Left lung	1(0.9)	1(1.8)	0	
Right lung	7(6.4)	5(9.2)	2(3.7)	0,241
Both lung	88(81.4)	41(75.9)	47(87)	0,137

CT: Computed Tomography
*p<0,05 statistically significant

Table 2. CT scores in mortality and survival groups

CT Features	All patients (n=108) mean±SD	Survival Group (n=54) mean±SD	Mortality Group (n=54) mean±SD	p
Right upper lobe	1.26 ± 1.02	0.88 ± 0.71	1.64 ± 1.15	0.001*
Right middle lobe	1.33 ± 1.16	1.07 ± 0.98	1.59 ± 1.26	0.019*
Right lower lobe	1.87 ± 1.34	1.38 ± 1.07	2.37 ± 1.41	0.001*
Left upper lobe	1.2 ± 0.95	0.88 ± 0.74	1.54 ± 1.01	0.001*
Left lower lobe	1.79 ± 1.39	1.31 ± 1.12	2.27 ± 1.47	0.001*
Total CT score	7.47± 5.18	5.53 ± 3.94	9.40 ± 5.57	0.001*

CT: Computed Tomography SD: Standard Deviation
*p<0,05 statistically significant

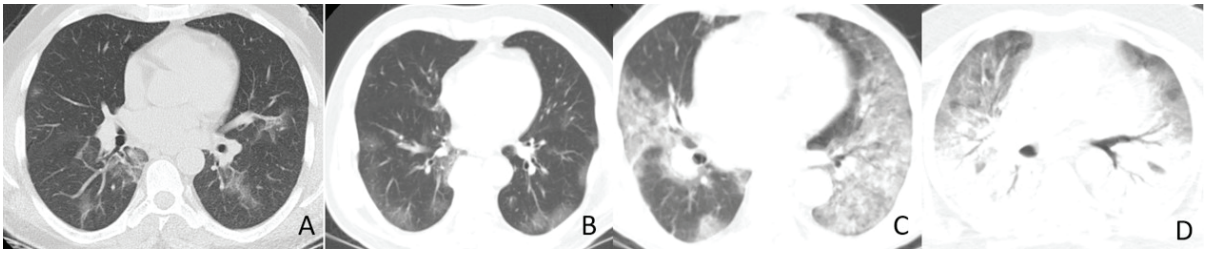

Figure 1. Representative computed tomography (CT) images of COVID-19 pneumonia. The CT images show multifocal bilateral ground-glass opacities (A, B, C) and ground-glass opacities with consolidations(D). Total CT score was A:3, B:6, C:15 and D:20

Mean global CT score of survival group was 5.53±3.94, while mortality group was 9.40±5.57. The score of mortality group was significantly higher than survival group (p=0.001).

DISCUSSION

COVID-19 pneumonia can cause respiratory failure and death, especially in elderly patients with comorbidities.[6,7] The treatment protocol is related the severity of the disease.[8] The fastest and most reliable method to determine the severity of the disease is CT.[9]

The average sensitivity of the diagnostic performance of CT for COVID-19 is 87.8% and the specificity is 66.4%.10 CT is widely used in the diagnosis of COVID-19, but is used in conjunction with PCR-RT to confirm the diagnosis.

There are different scoring methods used to determine the severity of the disease.[11,12] The CO-RADS classification, designed by the Dutch Radiology Association, has been described as simple and convenient, but has not yet been standardized.[10] CO-RADS assesses the suspicion for pulmonary involvement on CT. Accordingly, it has to be interpreted together with the duration and type of symptoms, as well as clinical and laboratory findings, when it comes to building a clinical diagnosis of COVID-19 with or without lung involvement. CO-RADS score, tested on a large sample of symptomatic patients, should be considered a valid tool for the identification of lung involvement in patients with suspected COVID-19. Moreover, the CO-RADS scheme has been developed specifically to be used in patients with moderate to severe symptoms.[13] But in CO-RADS a final diagnosis was not available for patients with false-positive CT findings.[14]

In a recent study by Michael et al., a scoring method used to show the severity of inflammation on CT images based on the degree of involvement of each lobe.[15] We used the same method to measure pulmonary inflammation and correlate it with disease prognosis.

Consistently with several recent reports regarding to CT findings of 2019-nCoV infected pneumonia (NCIP), our results showed that CT manifestations of NCIP were peripheral (34%), bilateral (81%) and lower lung zones (91%) being mostly involved.

Yiki H. et al. stated that 47-53% of patients who died from COVID-19 had GGO and consolidation and the total score average was 12.97 ± 5.87. The authors also showed that in patients who died from COVID-19, the total CT score increased significantly in follow-up imaging compared to the time of presentation. 16 In our study, the total CT score of mortality group was 9.40 ± 5.57 and survival group was 5.53 ± 3.94. The CT scores were significantly higher in mortality group compared to survival group.

As a conclusion,the imaging features and dynamic changes could provide the most direct evidence for assessing the

severity of the COVID-19 prognosis. We hope the simple scoring method according to CT scans may help triage patients and screening patients who need more aggressive treatment and closely monitoring. However, the efficacy of such approach to decrease mortality remains to be validated in future studies.

The study protocol was approved by the local ethics committee (Faculty of Medicine, Sakarya University, Date:22/09/2020-E.8423 No:71522473/050.01.04/504).

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