ORIGINAL ARTICLE

Evaluation of mediastinal lymphadenopathy from long-term radiological findings in COVID-19

Evaluación de la linfadenopatía mediastínica a partir de hallazgos radiológicos a largo plazo en COVID-19

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Abstract

Objective: *Mediastinal lymphadenopathy (MLAP) has been reported in post-COVID-19 patients. In this study, the relationship between post-COVID-19 infection and MLAP was investigated in patients who had been diagnosed with MLAP and decided to undergo surgery.* **Methods:** *The study included the records of 140 patients who had been diagnosed with MLAP and were decided for surgical treatment. Demographic findings, reverse transcription-polymerase chain reaction (PCR) test results, chest X-ray, thorax computed tomography (CT) findings, positron emission tomography (PET)-CT findings, and histopathological results were recorded.* **Results**: *SUV_{max} value above 2.5 was 15 times more common in patients with positive PCR test results than in patients with negative results. Abnormal chest X-ray results were associated with a 9.3-fold increase in the number of patients, and the number of patients with abnormal pathology results was 33.9 times higher than those with normal results.* **Conclusions:** *Post-COVID-19 and MLAP (SUV_{max} 3-5) were shown to be associated independently of age, gender, comorbidities, and disease outcomes. MLAP lesions in patients with COVID-19 demonstrated SUVmax values that were 10-fold higher compared to patients without COVID-19. Determining reliable SUV_{max} values in patients with severe COVID-19 may help guide clinical decisions, tailor therapeutic approaches, and avoid unnecessary surgical indications.*

Keywords: *Mediastinal lymphadenopathy. SUV_{max}. Surgical indication. Positron emission tomography. Post-COVID-19.*

Resumen

Objetivo: *Se ha informado linfadenopatía mediastínica en pacientes que se recuperan de COVID-19. Nuestro objetivo fue investigar si la linfadenopatía mediastínica encontrada en pacientes con neumonía grave por COVID-19 al menos 6 meses después de la infección está asociada con la enfermedad.* **Métodos:** *El estudio incluyó los registros de 140 pacientes a quienes se les había diagnosticado MLAP y se decidió que recibirían tratamiento quirúrgico. Los hallazgos demográficos se compararon mediante los resultados de RT-PCR, TC de tórax y PET-CT.* **Resultados:** *Un valor de SUV_{max} superior a 2,5 fue 15 veces más frecuente en pacientes con resultados positivos en la prueba PCR que en aquellos con resultados negativos. Los resultados anormales en la radiografía de tórax se asociaron con un aumento de 9,3 veces en el número de pacientes, y el número de pacientes con resultados anormales en las pruebas de anatomía patológica fue 33,9 veces mayor que el de aquellos con resultados normales.* **Conclusiones:** *Se demostró que la presencia de MLAP (SUV_{max} 3-5) tras la COVID-19 se asocia independientemente de la edad, el sexo, las comorbilidades y la evolución de la enfermedad. Las lesiones de MLAP en pacientes con COVID-19 mostraron valores de SUV_{max} 10 veces superiores a los de los pacientes sin COVID-19. Determinar valores fiables de SUV_{max} en pacientes con COVID-19 grave puede ayudar a orientar las decisiones clínicas, personalizar los enfoques terapéuticos y evitar indicaciones quirúrgicas innecesarias.*

Palabras clave: *Linfadenopatía mediastínica. SUV_{max}. Indicación quirúrgica. Tomografía por emisión de positrones. Post-COVID-19.*

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Introduction

Mediastinal lymph node enlargement is a critical computed tomography (CT) finding that can range from benign to malignant in patients with respiratory complaints and may require further examination. Since the presence of mediastinal lymphadenopathy (MLAP) is related to the severity of the disease in post-COVID patients who have had and recovered from severe COVID-19 infection, the presence of MLAP should be carefully examined in subsequent examinations, even in patients without lung involvement on admission CT[1]. The detection of MLAP in patients with idiopathic pulmonary fibrosis (IPF) is thought to be a result of high-grade chronic inflammation, and a correlation between the severity of IPF disease and MLAP has been shown in the literature[2].

When the current literature on MLAP and COVID-19 were examined, studies were conducted in the acute and active period of COVID-19 pneumonia. However, in our study, MLAP in the controls was performed 6-12 months after the patients had COVID-19 pneumonia. After suffering severe COVID-19 pneumonia, the mediastinal lymph nodes begin to enlarge during acute inflammation, which is considered a poor-prognosis marker at that time. After 6 months, this turns into chronic inflammation, and MLAP occurs. It is thought that there may be a correlation between the severity of chronic inflammation and mediastinal lymph node enlargement in patients with severe COVID-19 pneumonia, just as in IPF.

MLAP can be caused by infectious or non-infectious causes and is defined as a measurement of the lymph node short axis ≥ 10 mm. SUV_{max} value ≥ 2.5 was defined as pathological MLAP[3]. The most common atypical CT features of COVID-19 pneumonia are MLAP, linear opacities, tree bud sign, interlobular and intralobular septal thickening, cavitation, and pleural effusion[4]. MLAP is frequently associated with benign diseases such as heart failure, sarcoidosis, and diseases accompanying malignant diseases. Although MLAP is not the typical chest finding in COVID-19 pneumonia, it is associated with the prognosis of COVID-19 patients. The mortality rate in hospitalized COVID-19 patients with MLAP was found to be higher than in those without MLAP, and it has been reported in the literature that it should be investigated as a prognostic factor for severe disease. The literature shows a correlation between the severity of IPF disease and the presence of MLAP, suggesting that MLAP results from severe chronic inflammation in these patients[1,5,6].

For MLAP, the size and number of lymph nodes are essential for surgical treatment and follow-up. MLAP, usually over 2 cm in size, should be closely monitored regardless of the cause[6]. The radiological findings of one of our patients are shown in figure 1.

COVID-19 is a respiratory disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. In this study, we aimed to determine whether MLAP, which was detected in patients with severe COVID-19 pneumonia in the controls at least 6 months after the disease (post-COVID-19 period), was related to having the disease. If the detected MLAP formation is determined to be secondary to COVID-19 pneumonia, then immediate referral to the surgery clinic for further examination may be unnecessary. At the same time, by closely monitoring the patients in whom we detect MLAP, we can protect them from surgical complications and not be late in making the diagnosis.

Methods

This study was approved by the Ethical Committee of the University of Health Sciences Şişli Hamidiye Etfal Training and Research Hospital. Ethics Committee approval was granted by our institution on September 06, 2022, protocol number 2137. It was conducted according to the Declaration of Helsinki and Good Clinical Practice. The authors have obtained the approval of the Ethics Committee for the analysis and publication of clinical data obtained routinely. The informed consent of the patients was not required because it was a retrospective observational study. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Study population and data collection

Our study was a single-center, retrospective, case–control study. Our study analyzed the data of 140 patients who applied to our hospital's Şişli Hamidiye Etfal Training and Research Hospital Chest Diseases Outpatient Clinic between January 01, 2022, and August 01, 2022, and were reviewed retrospectively. During etiological investigations, individuals over 18 years old, regardless of gender, who applied to our hospital's chest diseases outpatient clinics with the MLAP, who had not been diagnosed with lymphoma and sarcoidosis, immunodeficiency, cancer,

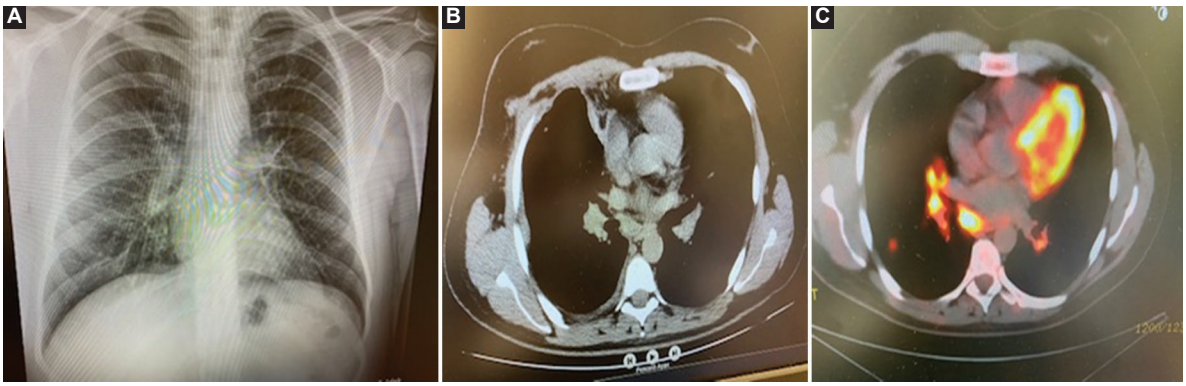

Figure 1. *A view from the chest radiograph of the patients*.* **A:** *a section with Hilar fullness from the chest X-ray findings of the patients.* **B:** *a section from the mediastinal window view with mediastinal lymphadenopathy.* **C:** *a section with positive fluorodeoxyglucose from positron emission tomography-computed tomography findings. *It was taken from the hospital file archives of the patients in our study, and their permission was obtained.*

tuberculosis, asthma, chronic obstructive pulmonary disease, and had no previous mediastinal pathology. Patients with MLAP detected in thorax CT examinations were included in the study. Patients with lung and other malignancies, under 18 years of age, pregnant women, and patients who had image artifacts on their CT scans were excluded from the study. A total of 140 cases who were followed up in our clinic and diagnosed with chest MLAP by CT were included in the study. These cases were divided into two categories: 83 cases with COVID-19 who had COVID-19 pneumonia and recovered, and 57 cases without COVID-19. The two categories were compared using data obtained from demographic characteristics, clinical findings, reverse transcription-polymerase chain reaction (RT-PCR) results, chest radiography findings, thorax CT findings, positron emission tomography (PET)-CT findings, histopathological results, and treatment approaches. Data were collected from the hospital automation system and analyzed with Statistical Package for the Social Sciences (SPSS) 24.

Sample size

The sample of the study was determined as a total of 140 patients, at least 51 in both groups, with an effect size of 0.40, a = 0.05, and power (1-b) = 0.85, using the G-power program. There were two groups: 57 patients without covid-19 and 83 patients with RT-PCR (+)

Image analysis

Demographic information, clinical findings, comorbidities, thorax CT, and PET-CT images were obtained from hospital computer records and Picture Archiving and Communication System. RT-PCR testing was performed using nasopharyngeal or oropharyngeal swabs using the Biospeedy SARS-CoV-2 Dual Gene RT-qPCR Kit (Bioeksen). Chest CT scans were performed with patients in the supine position, during last inspiration, and without intravenous contrast administration. The protocol included a peak voltage of 100 kV and an effective milliampere-second setting of 20 mA-s, resulting in unenhanced chest CT scans. These scans used a 512 × 512 pixel image matrix with 2 mm thin sections taken in the axial plane.

In this study, adjustments were applied to the mediastinal windows (width: 400 HU; level: 100 HU) and lung windows (width: 1500 HU; level: –500 HU). Tomography findings were evaluated by two experienced radiologists who agreed on the CO-RADS value. In routine axial CT images, the short axis of the mediastinal lymph node was measured, and if the short axis was 10 mm or more, it was considered MLAP. When the SUVmax value was ≥ 2.5 in the PET-CT examination of patients diagnosed with MLAP, fluorodeoxyglucose (FDG) uptake was considered pathological and was called “FDG positive”.

Statistical analysis

Patient data collected within the scope of the study were analyzed with the IBM SPSS for Windows 23.0 (IBM Corp., Armonk, NY) package program. Frequency and percentage were given for categorical data, and median, minimum, and maximum descriptive values for continuous data. The normality test of the data was conducted with the Kolmogorov–Smirnov Test. In the comparisons between the groups, the “Independent

Table 1. Distribution of demographic characteristics of all patients according to MLPA (lymph node short axis, SUV_{max} value)

Characteristics	Lymph node short axis			p	SUV_{max}			p
	10-20 (n = 103)	21-30 (n = 27)	> 30 (n = 10)		< 2.5 (n = 22)	2.5-5.0 (n = 51)	> 5.0 (n = 49)	
	n (%)	n (%)	n (%)		n (%)	n (%)	n (%)	
Age (years)				0.553				0.432
18-64	62 (60.2)	19 (70.4)	7 (70)		16 (72.7)	33 (64.7)	28 (57.1)	
65-94	41 (39.8)	8 (29.6)	3 (30)		6 (27.3)	18 (35.3)	21 (42.9)	
Gender				0.696				0.428
Male	64 (62.1)	15 (55.6)	7 (70)		16 (72.7)	29 (56.9)	29 (59.2)	
Female	39 (37.9)	12 (44.4)	3 (30)		6 (27.3)	22 (43.1)	20 (40.8)	
Smoking status				0.988				0.276
Smoker	44 (42.7)	13 (48.1)	4 (40)		13 (59.1)	22 (43.1)	20 (40.8)	
Non-smoker	38 (36.9)	9 (33.3)	4 (40)		8 (36.4)	21 (41.2)	17 (34.7)	
Ex-smoker	21 (20.4)	5 (18.5)	2 (20)		1 (4.5)	8 (15.7)	12 (24.5)	
Symptoms				0.058				0.275
Dyspnea	17 (16.5)	1 (3.7)	5 (50)		4 (18.2)	5 (9.8)	12 (24.5)	
Chest pain	14 (13.6)	5 (18.5)	1 (10)		1 (4.5)	9 (17.6)	7 (14.3)	
Cough	61 (59.2)	17 (63)	4 (40)		13 (59.1)	33 (64.7)	26 (53.1)	
Back pain	11 (10.7)	4 (14.8)	0 (0)		4 (18.2)	4 (7.8)	4 (8.2)	
Concomitant disease				0.118				0.950
Asthma	36 (38.7)	4 (15.4)	2 (20)		5 (27.8)	13 (26)	15 (34.1)	
DM	7 (7.5)	3 (11.5)	0 (0)		1 (5.6)	5 (10)	2 (4.5)	
GIS	5 (5.4)	3 (11.5)	2 (20)		2 (11.1)	6 (12)	2 (4.5)	
HT	13 (14)	4 (15.4)	1 (10)		3 (16.7)	7 (14)	8 (18.2)	
HD	6 (6.5)	2 (7.7)	3 (30)		2 (11.1)	5 (10)	3 (6.8)	
COPD	26 (28)	10 (38.5)	2 (20)		5 (27.8)	14 (28)	14 (31.8)	

DM: diabetes mellitus; GISD: gastrointestinal system diseases; HT: hypertension; COPD: chronic obstructive pulmonary disease; HD: heart disease; MLAP: mediastinal lymphadenopathy.

Sample T-Test" was used for those with normal distribution for the two groups, the "Mann-Whitney U Test" for those who did not show normal distribution, and the "Fisher's Exact Test or Chi-Square Test" was used for the comparison of categorical variables. Logistic regression analysis was used to examine the risk factors affecting the SUV_{max} value of ± 2.5. The results were considered statistically significant when $p < 0.05$.

Results

A total of 140 patients, 38.6% (n = 54) female and 61.4% (n = 86) male, were included in the evaluation. 40.7% (n = 57) of the patients were diagnosed without COVID-19, and 59.3% (n = 83) had positive RT-PCR test results, and it was determined that they had COVID-19. The distribution of demographic characteristics of all patients according to MLAP (lymph node short axis, SUV_{max} value) is shown in table 1. When table 1 was examined, no statistically significant difference was detected between demographic characteristics and mediastinal lymph node short axis and SUV_{max} values $p > 0.05$).

The distribution of demographic characteristics of the patients with COVİD-19 and without COVID-19 is denoted in table 2. When the table was examined, there was only a statistically significant difference between the two groups regarding age ($p < 0.05$).

Significant differences were observed between the two groups in all clinical findings ($p < 0.05$) (Table 3). Peripheral lymphadenopathy was in the intra-abdominal region in 24.1% (n = 20) of RT-PCR-positive with COVİD-19 patients and 3.5% (n = 2) of those without COVİD-19 patients ($p < 0.001$). Mediastinal width and lymph node size were higher in COVİD-19 patients than in non-COVID-19 patients ($p = 0.008$; $p < 0.001$). The pathology result of the majority of COVID-positive patients with COVİD-19 was benign (65%), whereas this rate was 22.8% in patients without COVİD-19 ($p < 0.001$). As a result, 77.2% of the patients without COVİD-19 PCR results regressed in the follow-up, whereas this rate was 24.1% in the patients with COVİD-19 ($p < 0.001$).

Table 4 elaborates on the logistic regression analysis results, examining the factors causing the SUV_{max}

Table 2. Distribution of demographic characteristics of patients with COVİD-19 and without COVİD-19

Characteristics	Total (n = 140)	without COVID-19 (n = 57)	with COVID-19 (n = 83)	p
	n (%) or Median (Min-Max)	n (%) or Median (Min-Max)	n (%) or Median (Min-Max)	
Age (years)	61 (20-94)	55 (22-78)	62 (20-94)	0.006
Gender				0.477
Male	86 (61.4)	33 (57.9)	53 (63.9)	
Female	54 (38.6)	24 (42.1)	30 (36.1)	
Smoking status				0.115
Smoker	61 (43.6)	25 (43.9)	36 (43.4)	
Non-smoker	51 (36.4)	25 (43.9)	26 (31.3)	
Exsmoker	28 (20)	7 (12.3)	21 (25.3)	
Symptoms				0.656
Dyspnea	23 (16.4)	8 (14)	15 (18.1)	
Chest pain	20 (14.3)	7 (12.3)	13 (15.7)	
Cough	82 (58.6)	34 (59.6)	48 (57.8)	
Back pain	15 (10.7)	8 (14)	7 (8.4)	
Concomitant disease	129 (92.1)	50 (87.7)	79 (95.2)	0.122
Asthma	42 (32.6)	19 (38)	23 (29.1)	
DM	10 (7.8)	5 (10)	5 (6.3)	
GIS	10 (7.8)	4 (8)	6 (7.6)	
HT	18 (14)	8 (16)	10 (12.7)	
HD	11 (8.5)	2 (4)	9 (11.4)	
COPD	38 (29.5)	12 (24)	26 (32.9)	

DM: diabetes mellitus; GISD: gastrointestinal system diseases; HT: hypertension; COPD: chronic obstructive pulmonary disease; HD: heart disease.

value to be ≥ 2.5 in the patients included in the study. COVİD-19 patients caused a 15-fold SUV_{max} value of ≥ 2.5. In addition, peripheral lymphadenopathy caused a 3.9-fold SUVmax value of ≥ 2.5, abnormal chest X-rays caused a 9.3-fold SUVmax value of ≥ 2.5, and abnormal pathology results led to a 33.9-fold SUV_{max} value of ≥ 2.5.

The statistically significant variables in the univariate model were re-evaluated in the multivariate model. RT-PCR positivity with COVİD-19 and abnormal pathology findings were statistically significant. Accordingly, it was determined that positive RT-PCR test results with COVİD-19 were 5.9 times higher than without COVİD-19 outcomes, and abnormal pathology results were found to be 13.4 times more frequently in SUV_{max} value being ≥ 2.5 compared to normal samples.

Discussion

In the study, MLAP was detected in the 6-month follow-up of patients with severe COVID-19, and the aim was to evaluate the relationship between these MLAP SUV_{max} values and having COVID-19 disease. While the frequency of MLAP in patients with COVID-19 pneumonia is 0-66% in the literature, the frequency of MLAP in this study (965 patients with COVID-19 pneumonia were scanned, and MLAP was detected in 83 and included in the study) was found to be 11.6%, similar to the literature[1,6,7].

Thorax tomography and PET-CT scans were performed on our patients who applied to us with respiratory complaints at least 6 months to 1 year after COVID-19, that is, during the post-COVID-19 patient controls. Diagnostic PET-CT was performed in patients with MLAP detected in thorax CT examination. In addition, we evaluated that MLAP size (SUV_{max} value) and FDG uptake are not associated with malignancy in patients with severe COVID-19, but may be associated with the severity of chronic inflammation.

Our results showed that mediastinal width and lymph node size were higher in patients with COVID-19 than in those without COVID-19. The pathology result of most COVID-19-positive patients was benign (65%), whereas this rate was 22.8% in patients without COVID-19. As a result, 77.2% of the patients without COVID-19 regressed in the follow-up, whereas this rate was 24.1% in the patients with COVID-19.

COVID-19-positive patients included in the study increased the incidence of MLAP ≥ 2.5 above the SUV_{max} value 15 times more than those without COVID-19. In addition, detecting peripheral lymphadenopathy in PET-CT increased the incidence of ≥ 2.5 times above the SUV_{max} value, 3.9 times more. Abnormal chest X-rays of the patients increased the incidence of ≥ 2.5 above the SUV_{max} value 9.3 times, and abnormal pathology results increased the incidence of ≥ 2.5 above the SUV_{max} value 33.9 times.

In our study, the chest X-ray findings of the patients without COVID-19 were mostly expected. In contrast, the chest X-ray of the patients with COVID-19-positive patients was found to be more abnormal, resulting in mediastinal enlargement and hilar lymphadenopathies[8-10]. The most common thorax CT finding detected in our study was M4R right lower paratracheal lymph node enlargement. Pulmonary parenchyma findings were deficient, and sequelae were reported as changes[11].

Regarding the results of our study, the presence of aggravated COVID-19 is linked with the occurrence of MLAP. COVID-19-positive patients and abnormal pathology results have indicated higher SUV_{max} values, thus the presence of lymphadenopathy. To date, MLAP has been observed widely in COVID-19 (0-66%).

Table 3. Distribution of clinical characteristics of patients with COVİD-19 and without COVİD-19

Characteristics	Total (n = 140)	Without COVID-19 (n = 57)	With COVID-19 (n = 83)	p
	n (%) or Median (Min-Max)	n (%) or Median (Min-Max)	n (%) or Median (Min-Max)	
Peripheric LAP				< 0.001
None	55 (39.3)	35 (61.4)	20 (24.1)	< 0.001
Cervical	43 (30.7)	15 (26.3)	28 (33.7)	0.454
Intraabdominal	22 (15.7)	2 (3.5)	20 (24.1)	< 0.001
Pelvic	4 (2.9)	1 (1.8)	3 (3.6)	0.646
Diffuse	16 (11.4)	4 (7)	12 (14.5)	0.276
Chest X-ray				0.002
Normal	78 (55.7)	42 (73.7)	36 (43.4)	< 0.001
Enlarged mediastinum	50 (35.7)	13 (22.8)	37 (44.6)	0.008
Hilar fulness	12 (8.6)	2 (3.5)	10 (12)	0.122
Computerize tomografi				0.024
M2R right upper paratracheal	39 (27.9)	14 (24.6)	25 (30.1)	0.597
M3 prevascular	20 (14.3)	12 (21.1)	8 (9.6)	0.099
M4R right lower paratracheal	39 (27.9)	21 (36.8)	18 (21.7)	0.049
M4L lower left paratracheal	14 (10)	3 (5.3)	11 (13.3)	0.207
M7 subcarinal	28 (20)	7 (12.3)	21 (25.3)	0.093
Lymph node size (mm)	17 (10-51)	15 (10-44)	18 (10-51)	< 0.001
SUV_{max}				< 0.001
FDG (-)	18 (12.9)	15 (26.3)	3 (3.6)	< 0.001
< 2.5	22 (15.7)	18 (31.6)	4 (4.8)	< 0.001
2.5-5.0	51 (36.4)	15 (26.3)	36 (43.4)	0.039
> 5.0	49 (35)	9 (15.8)	40 (48.2)	< 0.001
Pathology				< 0.001
None	57 (40.7)	40 (70.2)	17 (20.5)	< 0.001
Benign	67 (47.9)	13 (22.8)	54 (65.1)	< 0.001
Malign	16 (11.4)	4 (7)	12 (14.5)	0.276
Pathology result				< 0.001
Granulomatous lymphadenitis (benign)	20 (14.3)	4 (7)	16 (19.3)	0.073
Regressed at follow-up (benign)	64 (45.7)	44 (77.2)	20 (24.1)	< 0.001
Reactive lymph node (benign)	37 (26.4)	5 (8.8)	32 (38.6)	< 0.001
Anthracosis (benign)	3 (2.1)	0 (0)	3 (3.6)	0.271
Cancer metastasis (malignant)	16 (11.4)	4 (7)	12 (14.5)	0.276

LAP: lymphadenopathy; FDG: fluorodeoxyglucose.

However, it should be emphasized that not all lymphadenopathies are located in the mediastinal region. In published case reports, two cases (both female) are reported to have MLAP at the initial and repeated CT scan on the 6th day (1/6/10R and 2R/4R/4L)[12,13].

However, there are controversial data on this subject. Bayramoglu et al. indicated the presence of MLAP as 0-8.1% in their retrospective analysis[14]. In another retrospective research, no MLAP was found during pregnancy[15]. Grassi et al. found the incidence of MLAP as 1.3% in a cohort of 80 patients from Italy[16]. In two different studies (n = 418 and n = 134), the rate of MLAP was reported as 18.2% and 54.8%[16-18]. Fang et al. did not detect any association between MLAP and gender, age, cancer history, intensive care unit (ICU) admission, length of hospital stays, and laboratory parameters, but with cobblestone imaging findings[19]. In a French study, Valette et al. published that MLAP existed in six of nine individuals with severe COVID-19 in the ICU[20]. Studies from Chinese patients indicated the presence of MLAP at 43.5%, 41.7%, and 19.8%[18,19,21].

Kaya and Akman investigated the relationship between MLAP and ICU hospitalization and mortality in COVID-19 patients and found a statistical significance between the three parameters[6]. They claimed that the more severe findings on CT scans predict the prognosis. In addition, they stated that increased bronchial wall

Table 4. Laboratory parameters affecting $SUV_{max} \geq 2.5$

Characteristics	Univariant		Multivariant	
	Odds ratio (95% CI)	p	Odds ratio (95% CI)	p
Age	1.013 (0.990-1.037)	0.271		
Gender				
Male	Reference	-		
Female	1.690 (0.771-3.702)	0.190		
RT-PCR				
Negative	Reference	-	Reference	-
Positive	15.000 (5.856-38.058)	< 0.001	5.964 (1.937-18.370)	0.002
Peripheric LAP				
No	Reference	-	Reference	-
Yes	3.890 (1.801-8.398)	< 0.001	1.451 (0.491-4.289)	0.500
Chest X-Ray				
Normal	Reference	-	Reference	-
Abnormal	9.280 (3.355-25.662)	< 0.001	2.777 (0.758-10.165)	0.123
Pathology	Reference	-	Reference	-
Normal	33.857 (10.833-105.818)	< 0.001	13.452 (3.864-46.831)	< 0.001
Abnormal				

RT-PCR: reverse transcription-polymerase chain reaction; LAP: lymphadenopathy.

thickness was more common in patients with MLAP. The mortality rate was higher in patients with MLAP[1].

In another study, Satici et al.[22] reported that mediastinal lymphadenopathies were detected more in elderly patients with comorbid diseases and were significantly associated with mortality. The rate of MLAP was 9.2% in the whole study population but 19.65% in deceased individuals[21]. Both studies declared that the presence of MLAP led to increased mortality. Similar to our findings, mediastinal lymph node involvement has been an essential factor in COVID-19.

In the study of Bhatti et al.,[23] MLAP was detected in 131 (62.4%) of 210 patients included in the study. Covid-19 patients with MLAP had a higher mean and median severity score than those without MLAP. This study documents the high prevalence of MLAP in hospitalized COVID-19 patients and shows that the severity score, which represents the more severe course of the disease, is higher[22].

Limitations of our study

Since our study was retrospective, some laboratory findings and respiratory function findings could not be obtained. In this regard, a study can be organized to investigate the laboratory findings showing the severity of chronic inflammation in patients with severe COVID-19 pneumonia, respiratory functional characteristics, and the relationship between radiological imaging and MLAP features. Although this study is a retrospective observational study and provides valuable information about the potential etiology of the disease, it typically cannot definitively determine causality.

Conclusions

This study showed that severe COVID-19 and mediastinal lymph node involvement (SUV_{max}: 3-5) were associated regardless of age, gender, comorbidities, and disease outcomes. Establishing reliable SUVMAX values in severe post-COVID-19 patients will help guide clinical decisions, adapt therapeutic approaches, and avoid unnecessary surgical interventions for patients with MLAP who require surgical diagnosis and treatment, and will help these patients avoid surgery complications.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The authors have obtained approval from the Ethics Committee for the analysis of routinely obtained and anonymized clinical data, so informed consent was not necessary. Relevant guidelines were followed. The study was carried out with the permission of Health Sciences University Şişli Hamidiye Etfal Training and Research Hospital Ethics Committee (Date: September 06, 2022, Decision No:2137).

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

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