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Incidental Thorax CT Findings in Patients with Suspected COVID-19 Pneumonia

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Abstract

Objective: In this study, we aimed to emphasize the importance and frequency of incidental findings detected in chest computed tomography (CT) imaging with suspected coronavirus disease-2019 (COVID-19) pneumonia.

Methods: We evaluated lung nodules, emphysema, pleural and pericardial effusion, mediastinal and axillary lymphadenopathy (LAP), gallstones, kidney stones, hepatosteatosis, ascites, lung, breast, liver, adrenal gland, pancreas, and spleen masses whether or not the patients were positive for COVID-19 pneumonia and correlated with their gender and age. Polymerase chain reaction results of the patients were considered whose CT images were suspicious for COVID-19 pneumonia with chest CT. A total of 2,400 patients were included in the study. Patients who had major thoracic or abdominal operations, aged 18 and above 80 years, and images with artifacts were excluded from our study.

Results: In older patients, the COVID-19 positivity rate was higher in our study. We also found that the risk of positive COVID-19 results was higher in the presence of incidental findings regardless of their number. Furthermore, incidental findings such as mediastinal LAP (p=0.001), air cyst (p=0.021), and size above 5 mm parenchymal lung nodule (p=0.001) were higher in patients whose COVID-19 results were positive.

Conclusion: We demonstrated that clinicians and radiologists should be careful in terms of incidental findings when evaluating whether there is COVID-19 involvement in our study.

Keywords: Chest computed tomography, COVID-19 pneumonia, incidental findings, lung nodules, mediastinal lymphadenopathy

INTRODUCTION

Coronavirus disease-2019 (COVID-19) is the primary pandemic with a medical manifestation of an severe acute respiratory syndrome caused by coronavirus-2 (SARS-CoV-2) that was first detected in China in December 2019 (1). These signs may also progress to dyspenia and chest pain with pneumonia (2). Research has indicated that the intensity of symptoms can vary widely from fundamentally asymptomatic to mortal complications (3,4).

SARS-CoV-2 and Middle East respiratory syndrome (MERS-CoV) have similar symptoms and mechanisms. SARS-CoV-2 infection uses the angiotensin-converting enzyme 2 receptor, whereas MERS-CoV infection uses dipeptidyl peptidase 4 to enter human cells (5). Similar to pulmonary manifestations, patients can also present with vomiting, diarrhea, and stomach pain, which are atypical symptoms of the gastrointestinal (GI) system. Almost 20% of patients with COVID-19 present with GI signs and symptoms. Neurologic symptoms are prevalent at the same time in COVID-19 patients (6). There are numerous case reviews of individuals providing nothing but neurological symptoms, including confusion, headaches, diminished feeling of odor and taste, strokes, and seizures with encephalitis-like symptoms (3).

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Studies have demonstrated that COVID-19 patients with comorbidities may have a poor prognosis (7). A previous study suggested that individuals who are immunosuppressed do not exhibit a heightened susceptibility to severe pulmonary disease, and the factors that increase the likelihood of severe disease are advanced age, complications arising from obesity, coexisting medical conditions, and male gender (8). Conversely, alternative research revealed that individuals with immunodeficiency were at heightened susceptibility to experiencing more severe manifestations of COVID-19 and a greater likelihood of mortality (9). Research has verified that cancer patients are at a higher risk of intense COVID-19 symptoms and death than the normal population. Lung, blood, and metastatic cancer patients were identified as having the ultimate excessive consequences (10).

Patients with symptoms suggesting COVID-19 pneumonia underwent cross-sectional imaging that included portions of the abdomen out of necessity. In this study, we evaluated patients not known to be COVID-19 positive or negative who underwent computed tomography (CT) of the thorax for incidental findings such as lung nodules, emphysema, pleural and pericardial effusion, gallstones, kidney stones, lung, breast, and abdominal (liver, adrenal, pancreas, spleen) masses. We emphasized the importance and frequency of incidental findings detected by thoracic imaging.

METHODS

The study was conducted between March 11th and May 15th, 2020. This study received approval from the Human Subjects, University of Health Sciences Turkey, Bakırköy Dr. Sadi Konuk Training and Research Hospital Ethics Committee (approval no: 2022-08-05, date: 18.04.2022), and informed written consent was obtained from all patients. The study was conducted with 2,400 cases; 38.9% (n=934) were females and 61.1% (n=1,466) were males who had a suspicion of COVID-19 pneumonia. The ages of the patients ranged from 15 to 80, with an average of 46.62±15.43 years. We obtained all the medical and demographic information of the patients from the data processing center of our hospital.

All images were obtained using an MDCT scanner (Siemens Medical Solution, Erlanger, Germany) in the supine position with a CT protocol that was followed with a 1-mm slice thickness. Effective mAs were adjusted by Siemens "CARE dose", and the tube voltage was 120 kV. All patients underwent imaging from the thoracic inlet to the kidneys. CT images were transferred to an independent workstation (Syngo via console; Siemens, Erlangen, Germany) and then analyzed and evaluated.

We evaluated lung nodules, emphysema, pleural and pericardial effusion, mediastinal and axillary lymphadenopathy (LAP), gallstones, kidney stones, hepatosteatosis, ascites, lung, breast, liver, adrenal, pancreas, and spleen masses to determine whether or not the patients were positive for COVID-19 pneumonia and correlated these findings with their gender and age. Polymerase chain reaction (PCR) results of the patients were considered whose CT images were suspicious for COVID-19 pneumonia.

Patients who had major thoracic or abdominal operations, aged under 18 and above 80 years, were not included in the study. Furthermore, severe CT motion artifacts or other imaging artifacts were used as exclusion criteria. In this study, the first scans of patients who underwent repeated thoracic CT examinations were used for evaluation.

Statistical Analysis

The Number Breaker Statistics System (NBSS) 2007 (Kaysville, Utah, USA) program was used for statistical analysis. Descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, and maximum) were used to evaluate the study data. The suitability of quantitative data for a normal distribution was tested by the Kolmogorov-Smirnov test, the Shapiro-Wilk test, and graphical evaluations. Student's t-test was used to compare two groups of normally distributed quantitative data. For the comparison of qualitative data, the Pearson chi-square test and Fisher's exact test were used. Significance was evaluated at the level of $p<0.05$.

RESULTS

Approximately 317 images were excluded, depending on artifacts and major thoracic or abdominal operations. A total of 2,400 cases [61.1% (n=1,466) male, 38.9% (n=934) female] were evaluated in our study. While 37.1% (n=890) of the cases were under the age of 40, 23.2% (n=556) were between the ages of 40-49 years, 8.6% (n=446) were 50-59 years, 10.8% (n=258) were 60-69 years, and 10.4% (n=250) were over 70 years.

The COVID-19 results in 42.3% (n=1014) of the cases included in the study was positive (Table 1). While 39.1% (n=938) of the cases had no parenchymal lung nodule, 36.7% (n=880) had below 5 mm, and 24.3% (n=582) had 5 mm and above parenchymal lung nodules.

Emphysema in 7.7% (n=184), mediastinal LAP in 10.8% (n=260), lung mass in 2.8% (n=66), air cyst in 2.5% (n=60), cavitary lesion in 0.3% (n=6), pleural plaque in 1.2% (n=28), pleural effusion in 5.8% (n=138), pericardial effusion in 2.0% (n=48), breast mass in 1.1% (n=26), axillary LAP in 1.1% (n=26), hepatosteatosis in

Table 1. Distribution of descriptive features

		n	%
Age (years)	**Min-max (median)**	15-80 (45)	
	Mean ± SD	46.62±15.43	
	<40 years	890	37.1
	40-49 years	556	23.2
	50-59 years	446	18.6
	60-69 years	258	10.8
	≥70 years	250	10.4
Gender	Female	934	38.9
	Male	1466	61.1
COVID-19	Negative	1386	57.8
	Positive	1014	42.3
Parenchymal lung nodule	Negative	938	39.1
	<5 mm	880	36.7
	≥5 mm	582	24.3
Emphysema (+)		184	7.7
Mediastinal LAP (+)		260	10.8
Lung mass (+)		66	2.8
Air cyst (+)		60	2.5
Cavitary lesion (+)		6	0.3
Pleural plaque (+)		28	1.2
Pleural effusion (+)		138	5.8
Pericardial effusion (+)		48	2.0
Breast mass (+)		26	1.1
Axillary LAP (+)		26	1.1
Hepatosteatosis (+)		636	26.5
Liver mass (+)		220	9.2
Ascites (+)		14	0.6
Gallstones (+)		58	2.4
Adrenal mass (+)		134	5.6
Kidney mass (+)		196	8.2
Kidney stone (+)		96	4.0
Pancreatic mass (+)		10	0.4
Spleen mass (+)		10	0.4
Incidental findings	Negative	900	37.5
	Positive	1500	62.5
Total incidental findings	**Min-max (median)**	0-6 (1)	
	Mean ± SD	0.92±0.94	
	Negative	900	37.5
	1 finding	978	40.8
	2 findings	384	16.0
	≥3 findings	138	5.8

SD: Standard deviation, LAP: Lymphadenopathy, COVID-19: Coronavirus disease-2019, min: Minimum, max: Maximum

26.5% (n=636), liver mass in 9.2% (n=220), ascites in 0.6% (n=14), gallstones in 2.4% (n=58), adrenal mass in 5.6% (n=134), kidney mass in 8.2% (n=196), kidney stones in 4.0% (n=96), pancreatic mass in 0.4% (n=10), and spleen mass in 0.4% (n=10).

Incidental findings were not observed in 37.5% (n=900) of the patients, whereas they were observed in 62.5% (n=1500) of the patients. One incidental finding in 40.8% (n=978), two findings in 16.0% (n=384), and three or more findings in 5.8% (n=138) of the patients were determined (Table 2).

There was a statistically significant difference between the ages of the patients because of the presence of COVID-19 (p=0.001; p<0.05); the ages of COVID-19 cases were higher. There was no significant difference between the COVID-19 results by gender (p>0.05).

There was a statistically significant difference between the COVID-19 results of the cases in terms of parenchymal lung nodules (p=0.001; p<0.05). In CT examination, the rate of positive COVID-19 results among those with a nodule of 5 mm was higher than that of those with a parenchymal nodule of 5 mm (Figure 1).

COVID-19-positive rates did not differ statistically depending on findings such as emphysema, lung mass, cavitary lesion, pleural plaque, pleural effusion, pericardial effusion, breast mass, axillary LAP, hepatosteatosis, liver mass, ascites, gallbladder stone, adrenal mass, kidney mass, kidney stone, pancreatic mass, and spleen mass (p>0.05).

There was a statistically significant difference between the COVID-19 results of the patients in the presence of mediastial LAP (p=0.001; p<0.05); in cases with mediastinal LAP, the risk

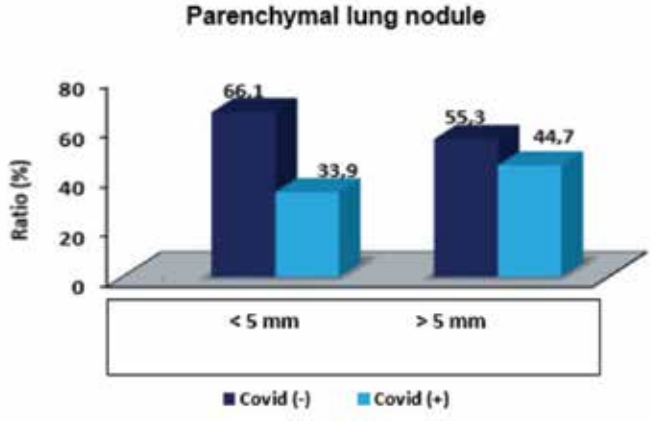

Figure 1. The rate of positive COVID-19 results of those who have a nodule of 5 mm and above was higher than those with a parenchymal nodule below 5 mm

COVID-19: Coronavirus disease-2019

Table 2. Assessments on COVID-19 presence				
		COVID-19		p
		Negative (n=1386)	Positive (n=1014)	
		n (%)	n (%)	
Age (years)	Min-max (median)	15-85 (43)	16-80 (47)	[a]0.001**
	Mean ± SD	45.25±15.59	48.49±15.03	
	<40 years	562 (63.1)	328 (36.9)	
	40-49 years	328 (59.0)	228 (41.0)	
	50-59 years	230 (51.6)	216 (48.4)	
	60-69 years	132 (51.2)	126 (48.8)	
	≥70 years	134 (53.6)	116 (46.4)	
Gender	Female	542 (58.0)	392 (42.0)	[b]0.875
	Male	844 (57.6)	622 (42.4)	
Parenchymal lung nodule	Negative	482 (51.4)	456 (48.6)	[b]0.001**
	<5 mm	582 (66.1)	298 (33.9)	
	≥5 mm	322 (55.3)	260 (44.7)	
Emphysema	Negative	1264 (57)	952 (43)	[b]0.084
	Positive	122 (66.3)	62 (33.7)	
Mediastinal LAP	Negative	1278 (59.7)	862 (40.3)	[b]0.001**
	Positive	108 (41.5)	152 (58.5)	
Lung mass	Negative	670 (57.4)	497 (42.6)	[b]0.159
	Positive	23 (69.7)	10 (30.3)	
Air cyst	Negative	1340 (57.3)	1000 (42.7)	[b]0.034*
	Positive	46 (76.7)	14 (23.3)	
Cavitary lesion	Negative	1384 (57.8)	1010 (42.2)	[c]0.577
	Positive	2 (33.3)	4 (66.7)	
Pleural plaque	Negative	1370 (57.8)	1002 (42.2)	[b]0.963
	Positive	32 (57.1)	12 (42.9)	
Pleural effusion	Negative	1310 (57.9)	952 (42.1)	[b]0.643
	Positive	76 (55.1)	62 (44.9)	
Pericardial effusion	Negative	1362 (57.9)	990 (42.1)	[b]0.437
	Positive	24 (50.0)	24 (50.0)	
Breast mass	Negative	1368 (57.6)	1006 (42.4)	[b]0.399
	Positive	18 (69.2)	8 (30.8)	
Axillary LAP	Negative	1370 (57.7)	1004 (42.3)	[b]0.781
	Positive	16 (61.5)	10 (38.5)	
Hepatosteatosis	Negative	1046 (59.3)	718 (40.7)	[b]0.071
	Positive	340 (53.5)	296 (46.5)	
Liver mass	Negative	1254 (57.5)	926 (42.5)	[b]0.616
	Positive	132 (60.0)	88 (40.0)	
Ascites	Negative	1380 (57.8)	1006 (42.2)	[c]0.464
	Positive	6 (42.9)	8 (57.1)	
Gallstones	Negative	1352 (57.7)	990 (42.3)	[b]0.923
	Positive	34 (58.6)	24 (41.4)	
Adrenal mass	Negative	1316 (58.1)	950 (41.9)	[b]0.347
	Positive	70 (52.2)	64 (47.8)	
Kidney mass	Negative	1276 (57.9)	928 (42.1)	[b]0.734
	Positive	110 (56.1)	86 (43.9)	
Kidney stone	Negative	1336 (58)	968 (42.0)	[b]0.417
	Positive	50 (52.1)	46 (47.9)	
Pancreatic mass	Negative	1378 (57.7)	1012 (42.3)	[c]0.404
	Positive	8 (80.0)	2 (20.0)	
Spleen mass	Negative	1378 (57.7)	1012 (42.3)	[c]0.404
	Positive	8 (80.0)	2 (20.0)	
Incidental findings	Negative	558 (62.0)	342 (38.0)	[b]0.021*
	Positive	828 (55.2)	672 (44.8)	

[a]Student t-test, [b]Pearson ki-kare test, [c]Fisher's exact test, *p<0.05, **p<0.01. SD: Standard deviation, LAP: Lymphadenopathy, COVID-19: Coronavirus disease-2019, min: Minimum, max: Maximum

of a positive COVID-19 result was 2.087 times higher. The odds ratio for mediastinal LAP was 2.087 [95% confidence interval (CI): 1.442-3.020] (Figure 2).

There was a statistically significant difference between the COVID-19 results of the cases based on the presence of air cysts ($p=0.034$; $p<0.05$); in cases without air cysts, the risk of a positive COVID-19 result was 2,452 times higher. The ODDS ratio for the air cyst was 2.452 (95% CI: 1.044-5.760).

There was a statistically significant difference between the COVID-19 results of the cases in the presence of incidental findings ($p=0.021$; $p<0.05$) (Figure 3); in cases with incidental findings, the risk of the COVID-19 result being positive was 1,324 times greater. The ODDS ratio for incidental findings was 1.324 (95% CI: 1.043-1.681). There was no statistically significant difference between the COVID-19 results and the number of incidental findings ($p>0.05$).

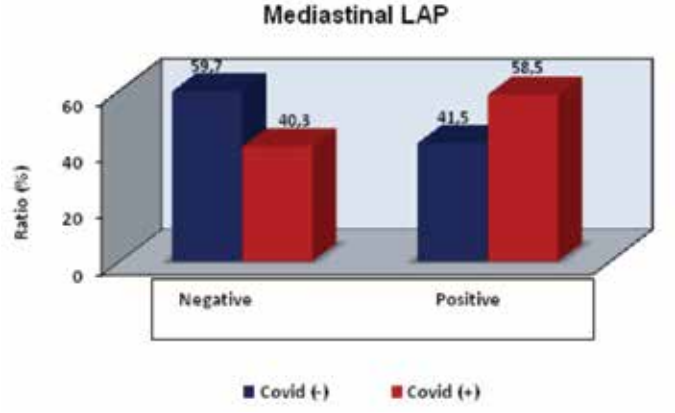

Figure 2. The risk of positive COVID-19 result was higher in cases with mediastinal LAP

LAP: Lymphadenopathy, COVID-19: Coronavirus disease-2019

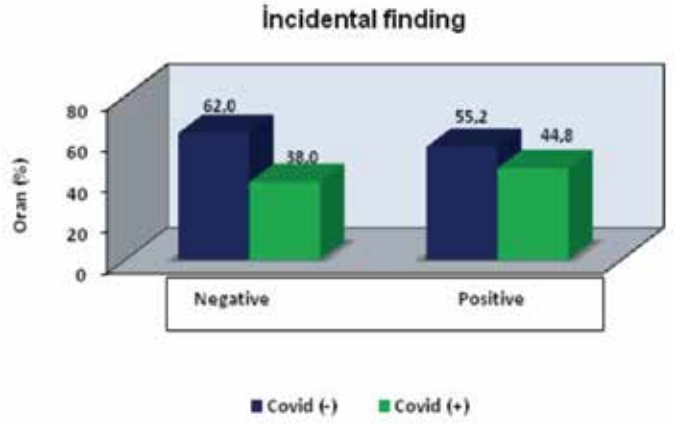

Figure 3. By the presence of incidental findings, there was a statistically significant difference between the COVID-19 results of the cases

COVID-19: Coronavirus disease-2019

DISCUSSION

In this study, we found that paraenchymal lung nodules smaller than 5 mm were the most common incidental finding in CT images, whether or not COVID-19 pneumonia was positive. Second, hepatosteatosis was the most common finding detected.

Under normal conditions, thoracic CT was not performed frequently; however, it was used as a screening method to determine whether there was COVID-19 pneumonia during the pandemic period. The detection of primary masses in patients has been based on the use of thoracic CT as a screening method during the pandemic period.

Chest X-ray examination has been indicated to have a lower susceptibility than chest CT examination, with CT having 93% sensitivity (11).

Kanesa-Thasan et al. (12) noticed that in 20.8% of patients with verified strokes who underwent computed tomography angiography (CTA) examination, incidental findings in the lung apices were present. Kihira et al. (13) confirmed that 37.5% of patients with verified stroke and 28% of all patients who had stroke had findings in the lung apex on CTA related to COVID-19 compatible with reverse transcription-PCR findings. They suggest that these findings can be the only sign of a patient's COVID-19 involvement during the first assessment of stroke patients, whereas other procedures take a long time to give results. Besides CTA imaging being the first modality used in the evaluation of suspected stroke patients, PCR has low trustworthiness and sensitivity.

Vuagnat et al. (14) showed that patients with breast cancer have the same imaging and clinical characteristics as a normal population. They also share the same risk factors (14). Hossain et al. (15) evaluated pulmonary findings of COVID-19 on non-chest CT images of patients with abdominal or neurological symptoms and emphasized the significance of assessing both lung aces or bases as findings may indicate COVID-19 pneumonia. Early diagnosis in these patients enables rapid treatment while helping management be performed correctly (15).

There have been several studies on COVID-19 patients presenting with GI symptoms. Gu et al. (16) reported that patients' symptoms presented proportionally with anorexia, vomiting, diarrhea, and abdominal pain.

Some patients have active colitis, which may be due to COVID-19-induced intestinal inflammation. The findings are similar to those of other viral, bacterial, and fungal infections, including mesenteric hypervascularity, mural hyperenhancement, circumferential wall thickening, and pericolic fat stranding (17).

A meta-analysis performed by Wang et al. (18) revealed that there was no correlation between malignancy, liver or renal disease, and COVID-19 aggravation. They concluded that cardiovascular and cerebrovascular disease, hypertension, and diabetes are increased risk factors for COVID-19 patients. Knowledge of these factors may be useful for clinicians to carry out suitable medical management of COVID-19 patients (18).

In older patients, the COVID-19 positivity rate was higher in our study. We also found that the risk of positive COVID-19 results was higher in the presence of incidental findings, regardless of their number. Furthermore, incidental findings such as mediastinal LAP, air cyst, and size above 5 mm of parenchymal lung nodule were higher in patients whose COVID-19 results were positive. To the best of our knowledge, a comparative study similar to our own has explored incidental findings in the form of intraparenchymal and extraparenchymal anomalies (19). The study revealed that the incidence of extraparenchymal incidental findings, such as LAP, breast lesions, thyroid nodules, bone, liver, and kidney lesions, was greater than that of parenchymal incidental findings, including primary malignant lung lesions, metastatic lesions, and benign pathologies, in contrast to our research. They found air cysts in one patient (0.06%), solitary pulmonary nodules in eight patients (0.52%), and mediastinal LAP in 48 patients (3.12%).

Radiologists must have a high degree of suspicion when assessing the lungs on chest CT examination for incidental findings in patients with suspected COVID-19. In our country, many thoracic CT images are taken daily, and they need to be reported quickly due to patient excess and for their treatment management to be done correctly. Therefore, clinicians and radiologists may omit other important findings, especially those that can be seen in abdominal images, including the examination area. In particular, early detection of lung or other organ masses in CT images helps the treatment and management of patients be done rapidly, and they may have a considerably better prognosis.

CONCLUSION

In conclusion, we demonstrated that clinicians and radiologists should be careful in terms of incidental findings when evaluating an examination to determine whether there is COVID-19 involvement. If adequate care is not taken during the assessment, important findings that can save the patient's life may be missed.

Ethics

Ethics Committee Approval: This study received approval from the Human Subjects, University of Health Sciences Turkey, Bakirköy Dr. Sadi Konuk Training and Research Hospital Ethics Committee (approval no: 2022-08-05, date: 18.04.2022).

Informed Consent: Written consent was obtained from all patients.

Peer-review: Externally peer reviewed.

Authorship Contributions

Surgical and Medical Practices: Ö.Y., E.H., Ö.P., G.T.A., Concept: M.O.N., E.H., E.İ., Design: M.O.N., Ö.Y., E.H., G.T.A., Data Collection or Processing: M.O.N., Ö.P., Analysis or Interpretation: M.O.N., E.İ., Literature Search: Ö.Y., E.İ., Ö.P., G.T.A., Writing: M.O.N., Ö.Y.

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