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ORIGINAL ARTICLE

Frequency of incidental findings of COVID 19 pneumonia on CT scan chest in patients undergoing CT imaging for some other indications.

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ABSTRACT… Objectives: To determine the frequency of incidental findings of COVID 19 pneumonia on CT scan chest in patients undergoing CT imaging for some other indications. **Study Design:** Descriptive, Cross sectional study. **Setting:** Department of Radiology, Allied Hospital, Faisalabad. **Period:** 4th August 2021 to 3rd February 2022. **Methods:** A total of 100 patients referred to radiology department for CT scan chest, individuals ranging from 15 to 65 years old, encompassing both male and female genders were included. Individuals with symptoms of COVID-19 and CRF were excluded. After taking informed consent, demographic features like age, gender, BMI, smoking (yes/no) were noted. Subsequently, all patients underwent a chest CT scan, revealing the inadvertent discovery of COVID-19 pneumonia. **Results:** In my study, frequency of incidental findings of COVID-19 pneumonia on chest CT scans among individuals undergoing CT imaging were consolidation (55.0%), ground glass opacities (80.0%), reticular pattern (47.0%) and air bronchograms (41.0%). **Conclusion:** This study concluded that ground glass opacities and consolidation are the commonest incidental observations of COVID-19 pneumonia on chest CT scans.

Key words: COVID-19 Patients, Consolidation, Ground Glass Opacities.

INTRODUCTION

Amid the global COVID-19 pandemic, individuals without symptoms who are infected PT can be utilized as a source of contagion for SARS-CoV-2. Some of these asymptomatic cases can quickly advance to acute respiratory distress syndrome and other systemic complications. Early identification has become paramount for swift prevention and timely intervention. Consequently, a multitude of healthcare professionals are actively engaged in addressing the public health crisis, often dealing with patients whose infection status is unknown. The distinctive features of chest CT imaging in asymptomatic individuals with COVID-19 pneumonia have been underscored, highlighting the crucial role of radiologists in this context.[1,2] The conclusive identification of COVID-19 is established through the use of real-time Reverse Transcription-Polymerase Chain Reaction (RT-PCR) on samples obtained from a nasopharyngeal swab or other respiratory specimens. Nevertheless, the effectiveness of RT-PCR is influenced by various factors, such as the precision of the sampling method and the viral load present during specimen collection. This variability accounts for the possibility of overlooking certain cases.[3]

An estimated 79% of COVID-19 infections are attributed to undocumented cases, comprising individuals who are asymptomatic or exhibit minimal symptoms. Asymptomatic individuals testing positive for COVID-19 hold a particularly significant role in the context of this pandemic.[4] Approximately 17.9% 5 to 30.8% 6 of all COVID-19 cases are believed to involve individuals who are asymptomatic carriers. Furthermore, within a pandemic scenario, individuals might downplay symptoms out of concern for potential quarantine, contributing to a rise in the count of undetected cases, as observed in India. Although real-time reverse transcription-polymerase chain reaction

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(RT-PCR) of viral nucleic acid is considered the benchmark for diagnosing COVID-19, recent studies have emphasized the significance of conducting chest computed tomography (CT) examinations in cases where RT-PCR results[4,5] prove to be falsely negative. These studies have indicated a CT sensitivity of 98%.[6] Furthermore, according to the recommendations specified in the sixth edition of China's National Health Commission official diagnosis and treatment protocol, CT scans are essential not only for diagnosing COVID-19 but also for tracking disease progression and evaluating the success of therapeutic interventions.

Interestingly, asymptomatic individuals are known to exhibit subtle pneumonia-related alterations on CT scans. The CT findings can manifest in different ways, encompassing ground-glass opacity (GGO), consolidation, or a combination of GGO and consolidation. Vascular enlargement, thickening of interlobular septa, and the presence of air bronchograms are also observable. The majority of these lesions are situated in the outer subpleural region, predominantly in the posterior or lower lobe. These lesions may progress from the periphery towards the central areas as they worsen.[8-11] A research conducted by Shi et al., 18.5% of individuals with COVID-19 pneumonia were identified as asymptomatic in their cohort of 81 individuals.[7] On the cruise ship "Diamond Princess," 54% of individuals who tested positive for asymptomatic COVID-19 displayed pneumonia-related alterations on chest CT scans. Among these, 83% predominantly exhibited ground glass opacities (GGO).[8]

Till date, very few studies are available on COVID-19 cases and also no such local study is yet done, the basis or justification for this research is to determine the frequency of incidental findings of COVID 19 pneumonia on CT scan chest in patients undergoing CT imaging for some other indications in local population. As there are ethnic and geographic variations in presentation and prevalence of COVID-19 cases, so I have opted to undertake this study in our population. The outcomes of this study will not only furnish us with regional statistics on the issue but will also offer valuable insights for healthcare practitioners for early screening of COVID-19 in these particular patients to decrease the incidence of illness and death in our patients.

OBJECTIVES & OPERATIONAL DEFINITIONS

OBJECTIVES

The objective of the research was:
"To determine the frequency of incidental findings of COVID 19 pneumonia on CT scan chest in patients undergoing CT imaging for some other indications."

Operational Definitions

CT features of COVID 19 pneumonia: presence of anyone of the following was taken as positive;

Consolidation: The substitution of normal alveolar air with abnormal fluids, cells, or tissues is apparent through an increased density in the pulmonary parenchyma, leading to the obscuration of the outlines of underlying vessels and airway walls.
Ground glass appearance: Cloudy regions with a mild density increase in the lungs, where bronchial and vascular margins remain visible, may occur due to incomplete filling of airspaces or thickening of the interstitium, leading to the partial displacement of air.

Reticular pattern: It was characterized as the an increase in the thickness of pulmonary interstitial structures, such as interlobular septa and intralobular lines, is noted as numerous small linear opacities on CT scans.
Air bronchogram: It was described as a configuration where bronchi filled with air (low-attenuation) stand out against a backdrop of lung tissue devoid of air, appearing opaque (high-attenuation) on imaging.
Smoking: history of >10 cigarettes /day for at least last one year.

METHODS

This Descriptive, Cross sectional study was done at Department of Radiology, Allied Hospital, Faisalabad from 4th August 2021 to 3rd February 2021.

The sample size was 100 and calculated as below:
Anticipated proportion = 54.0%8
Confidence Interval = 95%
Precision required (d) = 10%
Sample size (n) =100
Total 100 patients were included in the study

The sample technique used was Non-probability, consecutive sampling.

a. Inclusion Criteria
All patients referred to radiology department for CT scan chest.
Age from 15-65 years.
Both genders.

b. Exclusion Criteria
Pregnancy on medical record.
Patients with symptoms of COVID-19.
Patients with chronic renal failure (assessed on history and medical record).

Data Collection Procedure
Following approval from the ethical review committee , a total of 100 patients meeting the inclusion criteria were referred to the Radiology Department at Allied Hospital, Faisalabad. Subsequently, informed consent was obtained and demographic features like age, gender, BMI, smoking (yes/no) were noted. Then all patients were undergone CT scan chest and incidental finding of COVID-19 Pneumonia (as per-operational definition) were noted. The entirety of this data was documented using a specifically crafted recording system (Annexure I).

Statistical Analysis
The data entry and analysis were conducted utilizing SPSS version 25.0. Mean and standard deviation (SD) were computed for age and BMI, while frequencies and percentages were determined for categorical variables such as gender, smoking (yes/no), place of living (rural/urban), occupation (field/office/domestic) and incidental finding of COVID-19 Pneumonia (yes/no).

Effect modifiers like age, gender, BMI, smoking (yes/no), place of living (rural/urban) and occupation (field/office/domestic) were controlled through stratification. The post-stratification Chi-square test was employed, and a significance level of P-value ≤ 0.05 was deemed as statistically significant.

RESULTS

In this study, participants' ages spanned from 15 to 65 years, with an average age of 47.55 ± 7.85 years. The majority of patients, specifically 84 individuals (84.0%), fell within the age bracket of 41 to 65 years, as outlined in Table-I. Among the 100 participants, 67 (67.0%) were male, and 33 (33.0%) were female, resulting in a male-to-female ratio of 2:1. The mean Body Mass Index (BMI) was recorded as 29.55 ± 3.95 kg/m2. The distribution of patients in terms of other confounding variables is detailed in Table-II.

In my study, frequency of incidental findings of COVID 19 pneumonia on CT scan of chest in patients undergoing CT imaging were consolidation (55.0%), ground glass opacities (80.0%), reticular pattern (47.0%) and air bronchograms (41.0%) as shown in Table-III.

The categorization of COVID-19 pneumonia incidental findings categorized by age and gender is presented in Tables-IV and V, respectively. Tables-VI and VII illustrate the breakdown of incidental findings with regard to BMI and smoking, while Tables-VIII and IX depict the stratification based on place of living and occupation, respectively.

Age (in years)	No. of Patients	%age
15-40	16	16.0
41-65	84	84.0
Total	100	100.0

Table-I. Distribution of patients according to Age (n=100).

Mean ± SD = 47.55 ± 7.85 years

Confounding Variables		Frequency	%age
Gender	Male	67	67.0
	Female	33	33.0
BMI (kg/m2)	≤30	55	55.0
	>30	45	45.0
Smoking	Yes	44	44.0
	No	56	56.0
Place of living	Rural	37	37.0
	Urban	63	63.0
Occupation	Office	26	26.0
	Field	44	44.0
	Domestic	30	30.0

Table-II. Distribution of patients with status of other confounding variables.

Findings	No. of Patients	%age
Consolidation	55	55.0
Ground glass appearance	80	80.0
Reticular pattern	47	47.0
Air bronchogram	41	41.0

Table-III. Frequency of incidental findings of COVID 19 pneumonia on CT scan chest in patients undergoing CT imaging (n=100).

		15-40 (n=16)	41-65 (n=84)	P-Value
Consolidation	Yes	08 (50.0%)	47 (55.95%)	0.661
	No	08 (50.0%)	37 (44.05%)	
Ground glass appearance	Yes	12 (75.0%)	68 (80.95%)	0.585
	No	04 (25.0%)	16 (19.05%)	
Reticular pattern	Yes	09 (56.25%)	38 (45.24%)	0.353
	No	07 (43.75%)	46 (54.76%)	
Air bronchogram	Yes	08 (50.0%)	34 (40.48%)	0.479
	No	08 (50.0%)	50 (59.52%)	

Table-IV. Stratification of the incidental findings of COVID 19 pneumonia with respect to age.

		Male (n=67)	Female (n=33)	P-Value
Consolidation	Yes	38 (56.72%)	17 (51.52%)	0.623
	No	29 (43.28%)	16 (48.48%)	
Ground glass appearance	Yes	51 (76.12%)	29 (87.88%)	0.167
	No	16 (23.88%)	04 (12.12%)	
Reticular pattern	Yes	31 (46.27%)	16 (48.48%)	0.835
	No	36 (53.73%)	17 (51.52%)	
Air bronchogram	Yes	27 (40.30%)	14 (42.42%)	0.839
	No	40 (59.70%)	19 (57.58%)	

Table-V. Stratification of the incidental findings of COVID 19 pneumonia with respect to gender.

		≤30 (n=55)	>30 (n=45)	P-Value
Consolidation	Yes	31 (56.36%)	24 (53.33%)	0.762
	No	24 (43.64%)	21 (46.67%)	
Ground glass appearance	Yes	45 (81.82%)	35 (77.78%)	0.615
	No	10 (18.18%)	10 (22.22%)	
Reticular pattern	Yes	22 (40.0%)	25 (55.56%)	0.142
	No	32 (60.0%)	20 (44.44%)	
Air bronchogram	Yes	24 (43.64%)	17 (37.78%)	0.553
	No	31 (56.36%)	28 (62.22%)	

Table-VI. Stratification of the incidental findings of COVID 19 pneumonia with respect to BMI.

		Yes (n=44)	No (n=56)	P-Value
Consolidation	Yes	23 (52.27%)	32 (57.14%)	0.627
	No	21 (47.73%)	24 (42.86%)	
Ground glass appearance	Yes	34 (77.27%)	46 (82.14%)	0.546
	No	10 (22.73%)	10 (17.86%)	
Reticular pattern	Yes	21 (47.73%)	26 (46.43%)	0.897
	No	23 (52.27%)	30 (53.57%)	
Air bronchogram	Yes	15 (34.09%)	26 (46.43%)	0.213
	No	29 (65.91%)	30 (53.57%)	

Table-VII. Stratification of the incidental findings of COVID 19 pneumonia with respect to smoking.

		Rural (n=37)	Urban (n=63)	P-Value
Consolidation	Yes	25 (67.57%)	30 (47.62%)	0.053
	No	12 (32.43%)	33 (52.38%)	
Ground glass appearance	Yes	29 (78.38%)	51 (80.95%)	0.756
	No	08 (21.62%)	12 (19.05%)	
Reticular pattern	Yes	10 (27.03%)	37 (58.73%)	0.002
	No	27 (72.97%)	26 (41.27%)	
Air bronchogram	Yes	19 (51.35%)	22 (34.92%)	0.107
	No	18 (48.65%)	41 (65.08%)	

Table-VIII. Stratification of the incidental findings of COVID 19 pneumonia with respect to place of living.

		Office (n=26)	Field (n=44)	Domestic (n=30)	P-Value
Consolidations	Yes	13 (50.0%)	24 (54.55%)	18 (60.0%)	0.752
	No	13 (50.0%)	20 (45.45%)	12 (40.0%)	
Ground glass appearance	Yes	20 (76.92%)	38 (86.36%)	22 (73.33%)	0.349
	No	06 (23.08%)	06 (13.64%)	08 (26.67%)	
Reticular pattern	Yes	14 (53.85%)	23 (52.27%)	10 (33.33%)	0.199
	No	12 (46.15%)	21 (47.73%)	20 (66.67%)	
Air bronchogram	Yes	08 (30.77%)	15 (34.09%)	18 (60.0%)	0.039
	No	18 (69.23%)	29 (65.91%)	12 (40.0%)	

Table-IX. Stratification of the incidental findings of COVID 19 pneumonia with respect to occupation.

DISCUSSION

The global prevalence of Coronavirus Disease 2019 (COVID-19)[9], resulting from the infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)[10], escalated significantly, attaining pandemic status in March 2020.[11] Although many radiology professional organizations advise against conducting screening CT scans to detect COVID-19[12,13], there is an expected rise in the quantity of CT scans conducted for individuals being examined as potential cases of COVID-19. Moreover, there is an expectation that patients might display incidental lung observations on CT scans performed for unrelated reasons, potentially associated with COVID-19.

Many recent articles have provided in-depth information on the CT imaging traits of COVID-19, the evolution of these features over time, and the capacity of radiologists to distinguish COVID-19 from other viral infections.[14-18] These studies have shown that COVID-19 often displays a CT pattern resembling organizing pneumonia, marked by peripheral ground-glass opacities (GGOs) and nodular or mass-like GGOs that typically manifest bilaterally and in multiple lobes.[19] Nevertheless, other imaging observations have been documented, such as linear, curvilinear, or perilobular opacities, consolidation, and widespread ground-glass opacities (GGOs). These findings can resemble various disease conditions, incorporating various infections, inhalational exposures, and toxicities related to drug use.[20-23]

I conducted a study to assess the occurrence of inadvertent findings of COVID-19 pneumonia on chest CT scans in patients undergoing CT imaging. In my research, the prevalence of unintended findings of COVID-19 pneumonia on CT scans of chest in individuals undergoing CT imaging included consolidation (55.0%), ground glass opacities (80.0%), reticular patterns (47.0%), and air bronchograms (41.0%). Shi et al., in their examination of 81 individuals diagnosed with COVID-19-related pneumonia, discovered that 18.5% of the patients were asymptomatic.[7] In the case of the "Diamond Princess" cruise ship, 54% of asymptomatic individuals with COVID-19 exhibited pneumonia-related changes on chest CT, with 83% of them manifesting as ground glass opacities (GGO).[8]

Meng et al. observed that 95% of asymptomatic patients in their study exhibited ground glass opacities (GGOs), while 5% showed consolidation. The distribution was primarily subpleural (76%), mainly affecting one or two lung lobes (65.5%), predominantly in the lower lobes, and with a higher prevalence in the right lung compared to the

left.[24] In a different study involving asymptomatic subjects, over 90% displayed ground glass opacities (GGOs), and the remaining individuals exhibited mild consolidations affecting fewer than 5 lung segments.[25]

Zhang et al. conducted a study comparing CT features in entirely asymptomatic individuals and those with typical symptomatic presentations, excluding severe cases determined by criteria such as a breathing rate ≥30/min, saturation ≤93%, mechanical ventilation, shock, or other organ failure. The findings indicated no significant differences in individual signs, patterns, zonal predominance, or the extent of CT abnormalities between common symptomatic and asymptomatic patients.[26] In a recent meta-analysis conducted by Ishfaq A. et al., it was revealed that among individuals with COVID-19, 71.64% exhibited ground glass opacities (GGOs), 43.28% had interlobular septal thickening, 24.47% showed crazy paving, 55.61% displayed subpleural bands, 65.41% demonstrated vascular dilatation, 29.15% presented with consolidation, 20.71% had bronchial wall thickening, 7.64% showed lymphadenopathy, 5.09% had pleural effusion, and 14.84% exhibited parenchymal nodules.[27]

Numerous studies have reported that COVID-19 commonly manifests as ground glass opacities (GGO) with or without consolidation, exhibiting a distribution pattern primarily in the peripheral, posterior, and diffuse areas or lower lung zones.[28-32] Ground glass opacities (GGO) have been commonly described with either a round morphology or a pattern resembling "crazy paving."[28,31] However, a significant proportion of cases show opacities lacking a clear or specific distribution.[31] No documented cases showed a prevailing perihilar pattern. Furthermore, typical features found in infections, such as bronchial wall thickening, mucoid impactions, and nodules like "tree-in-bud" and centrilobular nodules, are generally absent.[31] Lymphadenopathy and pleural effusion have been rarely observed.[28]

Bernheim et al. conducted an analysis of CT findings in 121 symptomatic individuals with COVID-19, investigating the correlation between the onset of symptoms and the first CT scan. Their findings indicate that individuals who sought medical attention earlier tended to exhibit fewer ground glass opacities (GGO) and consolidations compared to those who appeared for medical evaluation at intermediate or later stages.[34] Qiongjie and colleagues observed that initial pulmonary CT scans of individual suffering from COVID-19 pneumonia commonly exhibited ground glass opacities, that may or may not accompany consolidation. These abnormalities were predominantly situated in the peripheral or subpleural regions, accompanied by pulmonary artery dilation and air bronchograms. Nonetheless, it is worth noting that the early presentation of COVID-19 in some cases did not follow this typical pattern. Approximately 34.78% of solitary lesions were situated in the central area.[35]

According to Song et al, ground glass opacities (GGO) were documented at a rate of 77%, while consolidation and GGO occurred in 59%, and consolidation alone was observed in 55%.[36] On the other hand, Long et al reported GGO at 30.6%, consolidation and GGO at 52.7%, and consolidation alone at 16.7%.[37] Zhu et al conducted a meta-analysis revealing that 73.8% of patients exhibited bilateral lung involvement, 67.3% had involvement in multiple lobes, and 8.4% displayed normal CT findings. The density of lesions included ground-glass opacities in 68.1%, the air bronchogram sign in 44.7%, a crazy-paving pattern in 35.6%, and consolidation in 32% of patients.[38]

Our study has certain limitations, including a relatively small sample size, being conducted at a single center, and having a short observation period. Enhancing the study's robustness could be achieved by including a larger number of patients. Nevertheless, due to the challenges posed by the ongoing pandemic, augmenting the patient cohort proved impractical, as it would have complicated the assessment of CT scans and patient follow-up under the current working conditions.

CONCLUSION

The findings of this study indicate that ground glass opacities and consolidation are the most frequently observed incidental results of COVID-19 pneumonia in chest CT scans. So, we recommend that early screening of COVID-19 in these particular patients should be done in order to reduce the morbidity and mortality of our patients.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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