



RESEARCH ARTICLE

PATTERNS OF CHEST COMPUTED TOMOGRAPHY FINDINGS IN COVID-19 PATIENTS IN PORT HARCOURT RIVERS STATE, NIGERIA

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Abstract

Background: The novel coronavirus disease (COVID-19) is usually under diagnosed in resource-constrained countries as Africa. Although Real-time-reverse-transcription polymerase chain reaction (RT-PCR) testing is considered to be the gold standard tool to diagnose or screen for COVID-19, chest imaging is a valuable tool to support the diagnosis of COVID-19 pneumonia. Therefore, Radiologists usually play an important role in the diagnosis of COVID-19 pneumonia, especially in resource-constrained environments. This study aimed to evaluate the patterns of chest CT findings in covid-19 pneumonia and to emphasize its diagnostic value in coronavirus disease. **Method:** This study was a retrospective cross-sectional study conducted in a reputable diagnostic center in Port Harcourt and comprised of 13 chest CT images diagnosed of Covid-19 pneumonia that met the inclusion criteria set for this study. All the chest CT examinations were performed by registered radiographers on a 64-slice CT scanner (GE Optima CT660, GE medical systems). Results: Chest CT findings in patients with confirmed covid-19 infection was evaluated and the results revealed that 13 (100%) had GGO. Out of 13 patients with GGO, bilateral distribution of the opacities was found in 11(84.62%), followed by peripheral opacities 9(69%) and the least 2 (15.38%) was unilateral distribution.

Conclusion: The commonest chest CT appearance of covid-19 pneumonia is bilateral GGO with a predilection for the lower lobes of the lungs. Radiologists and clinicians should take cognizance of imaging appearances and diagnostic capabilities of Chest CT in covid-19 pneumonia, especially in the context of the current pandemic.

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Introduction:-

The attention of the World Health Organization (WHO) was drawn to the emergence of unusual pneumonia of unknown etiology, which was diagnosed among fish sellers and visitors to the Huanan Seafood Wholesale Market, in Wuhan city, China [1]. This unusual bilateral interstitial pneumonia was later found to be caused by a coronavirus, a nonsegmented, single-stranded, positive-sense ribonucleic acid viruses [2]. The World Health Organization (WHO) named this clinical condition 2019 Novel Coronavirus Disease (Abbreviated Covid-19)[3]. The disease soon spread all over the world except Antarctica [4], attaining a pandemic status with many lives lost and devastation of the world economy. In Africa, the WHO identified a lot of countries at the top risk of Covid-19 infection including Nigeria. This was attributed to the direct link or greater number of people traveling to and from China [5]. In Nigeria, Port Harcourt is located in the Niger Delta, the center of the hydrocarbon and playing host to many multinational industries where many foreigners are gainfully employed. The Covid-19 pandemic is ongoing and many cases of Covid-19 have been reported in Port Harcourt.

At present, the reference standard for diagnosing Covid-19 is the real-time reverse-transcriptase-polymerase-chain-reaction (RT-PCR). However, in our setting, the RT-PCR test is not readily available, is expensive, and takes a long time, more than 72hrs for the result to be available. Furthermore, the sensitivity of PT-PCR diagnostic kit performance may be suboptimal due to low viral load particularly in the early stage of the infection or technical factors[6]. In Port Harcourt metropolis Computed Tomography (CT) imaging is readily available and preliminary reports can be ready in less than 24 hours. Chest CT can play a great role in the diagnosis of covid-19 pneumonia as it can depict some characteristic features in almost all patients with covid-19 pneumonia.[7,8] Fang et al.[9] and Ng et al[10] in their separate studies documented that in patients with suspected Covid-19 pneumonia, chest CT imaging may play a great role in the detection of interstitial pneumonia. The sensitivity of chest CT in the diagnosis of covid-19 pneumonia has been emphasized by different authors [11,12]. Similarly, Ai et al[13] in their study in Wuhan China put the sensitivity of chest CT in Covid-19 pneumonia at 97%. Gietema et al[14] reported 100% sensitivity in patients with severe risk pneumonia than in patients with low/medium risk pneumonia (88.3%, $p=0.38$). In this part of the world, less attention is paid to Covid-19 symptoms as people presenting with fever, chills, headache, vomiting, cough, etc are first treated as plasmodiasis (malaria). Covid-19 cases were underdiagnosed as some of these patients who developed breathlessness were diagnosed as pulmonary embolism and referred for CT pulmonary angiography. Covid-19 was least suspected by the clinicians and a greater number of cases of Covid-19 pneumonia were first diagnosed by the radiologists. Good knowledge of the patterns of Covid-19 chest CT manifestations and its diagnostic value is necessary for radiologists to make an accurate diagnosis as well clinicians to make an informed decision in the choice of investigation in an emergency situation. There is a dearth of data on the performance of chest CT in COVID-19 pneumonia in our environment. To the best of our knowledge, this is the first attempt at documenting the value of CT imaging in Covid-19 pneumonia in our setting. This study aimed to evaluate the patterns of chest CT findings in covid-19 pneumonia and to emphasize its diagnostic value in coronavirus disease.

Materials and methods:-**Study design and setting**

This study was a retrospective cross-sectional study conducted at the Radiology Department of a reputable Diagnostic Centre in Port Harcourt City Local government Area, Rivers State, Nigeria between February and April 2021.

Ethical consideration

This study was approved by the Human Research and Ethical Committee of the institution and written informed consent was waived due to the retrospective nature of the study.

Patient population

This comprised of 13 chest CT images diagnosed of Covid-19 pneumonia that met the inclusion criteria set for this study.

Inclusion and exclusion criteria

Chest CT images of patients with positive PT-PCR assay and adequately filled request forms were included. Chest CT images of patients without PT-PCR assay and those that had negative PT-PCR assay were excluded from this study.

CT- image acquisition and analysis

All the chest CT examinations were performed by registered radiographers on a 64-slice CT scanner (GE Optima CT660, GE medical systems). The technical image acquisition parameters used in this study include: tube current modulation: 110-270mAs, tube voltage; 100-120KV, helical pitch factor: 0.86, DFOV: SFOV: Collimation width, Slice thickness: 1.3mm, Slice interval: 1.3mm, reconstruction algorithms: Standard, Window Center: 50, Window Width: 500. In the analysis of the acquired images, were retrieved from the picture archiving and communication workstation (version: GE, Medical Systems). Two consultant radiologists (RA) and (AM) with more than 5 years and 8 years experience respectively in general radiology, jointly reviewed the images to identify the main findings of the images. The image findings were documented based on the radiologists' consensus. Where there was doubt, disagreement, or inability to come to a consensus by the two radiologists, a third independent senior consultant radiologist with over 10 years experience in general radiology was contacted to ascertain the image findings. A typical CT image finding in COVID-19 positive patients reported include but are not limited to, ground-glass opacities (GGOs), GGO pattern and location, consolidation, multilobe involvement, pulmonary nodules surrounded by GGO (Halo sign), Crazy paving, bilateral distribution, air bronchogram, lung cavitation, pleural effusion, pericardial effusion, cyst lymphadenopathy, and subsegmental vessel enlargement [7, 15]. Our reference standard was based on typical chest CT imaging findings and positive PT-PCR assay.

Statistical analysis

The generated data were collected using data capture design for this study and the statistical analysis was done using Statistical Package for Social sciences Version 21 by employing descriptive statistical tools such as tables, frequency, percentage and mean.

Results:-

Out of 13 males CT chest images used for this study, the majority 4 (30%) were 73 years of age (Table 1). The overall mean age of the cases was 60 years. Chest CT findings in patients with confirmed covid-19 infection were evaluated and the result revealed that 13 (100%) had GGO. Out of 13 patients with GGO, bilateral distribution of the opacities was found in 11 (84.62%) (Figure 1), followed by peripheral opacities 9 (69%) (Figure 2), and the least was unilateral distribution, which is 2 (15.38%) (Table 2).

The majority 6 (46.15%) of the cases had all the lungs lobes involved while least 3 (23.07%) involved the middle lung's lobe. The greater number of the cases 4 (30%) had crazy-paving characteristics of the GGO (Figure 3) and the least had sub-segmental vessel enlargement and linear opacities, which is 1 (7.69%) respectively. Out of 13 cases, only 1 (7.69%) had cyst as other findings (Table 2)

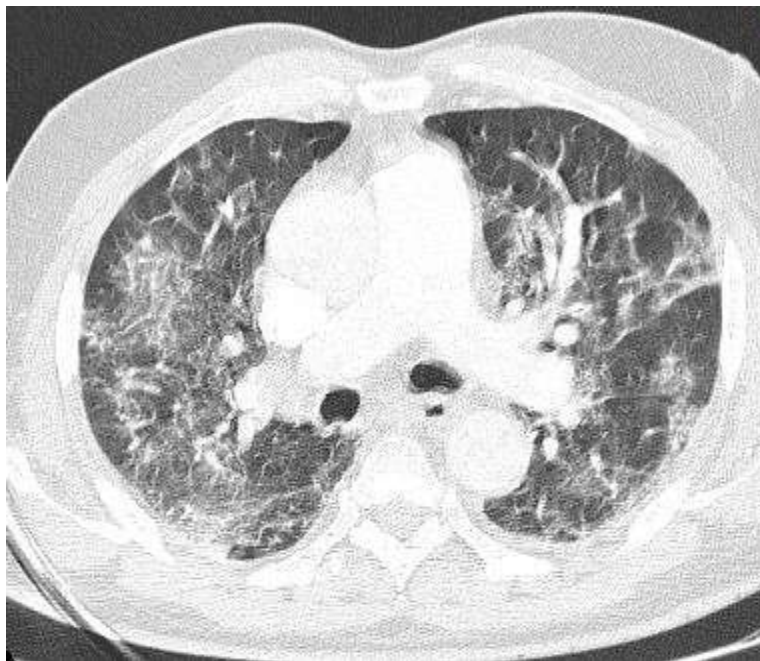


Figure 1:- Axial thin slice non-contrast CT image shows bilateral ground-glass opacities.

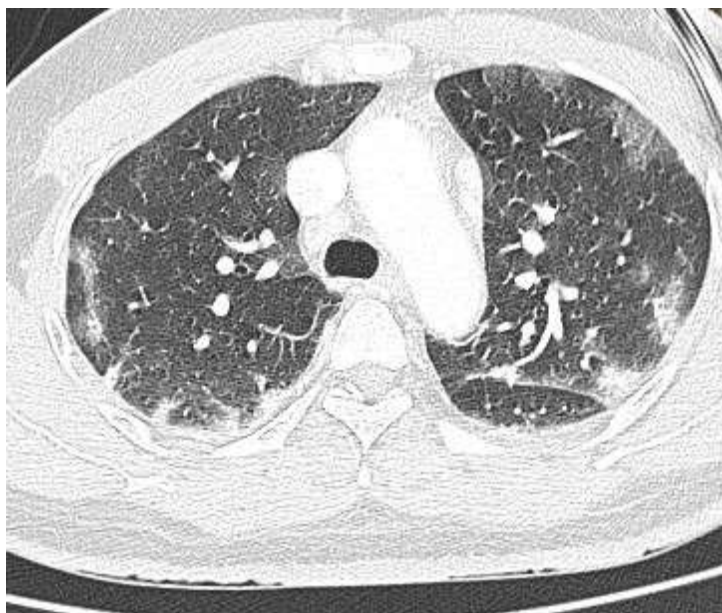


Figure 2:- Bilateral ground-glass opacities, mainly peripheral and subpleural distribution



Figure 3:- Axial thin section non-contrast chest CT image shows bilateral apical ground glass opacities with the crazy-paving pattern.

Table 1:- Age and sex distributions of the patients

PATIENTS	A	B	C	D	E	F	G	H	I	J	K	L	M
AGES	60	75	36	30	73	73	58	73	45	65	73	56	55
Sex	M	M	M	M	M	M	M	M	M	M	M	M	M

Table 2:-Distributions of GGO among Patients –(A-M)

DISTRIBUTION OF GGO	A	B	C	D	E	F	G	H	I	J	K	L	M	Total
- Bilateral	1	1	1		1	1	1	1	1	1	1	1		11
- Unilateral				1									1	2
- Peripheral	1	1		1			1	1	1	1		1	1	9
- Central and peripheral			1		1	1					1			4
INVOLVED LUNG ZONES														
- Middle	1									1			1	3
- Lower	1	1		1				1	1	1				4
- All			1		1	1	1				1	1		6
CHARACTERISTICS OF OPACITIES														
Pure GGO														13
OR with the under listed														
- Linear opacities								1						1
- Rounded morphology					1				1			1		3
- Crazy-paving			1			1				1	1			4
- Reverse halo sign													1	1
- Patchy				1			1					1		3
Subsegmental vessel enlargement									1					1
OTHER FINDINGS														
- Cyst.													1	1

Discussion:-

Ground glass opacity (GGO) is the undefined hazy opacifications of the lung seen in the computed tomography chest images with no obliteration of the bronchial markings. This disease condition with this radiological feature usually includes; partial filling of the lung alveoli by fluid, interstitial thickening, or partial collapse of lung alveoli [16].

In our study, GGO which was described as patchy, bilateral, subpleural, and peripheral was the most common findings in chest CT. Our findings were following other studies like those conducted by Bao et al [17], Zhu et al [18], Guan et al [19], Ng et al [10], Shi et al [20], Pan et al [21], Song et al [1], Duan and Qin [22], Guan et al [23] and Bernheim et al [24], which also reported GGO as the most common chest CT imaging findings in patients diagnosed with Covid-19. Contrary to our findings, Wu et al [25] and Zhang et al [26] studies, did not report GGO as the most common finding. This discrepancy in our findings could be attributed to the different nature of our various studies.

Anatomical distribution of the GGO was evaluated and the result revealed that bilateral distribution of the opacities was commonly found among our study population followed by peripheral distribution. These findings are in agreement with the findings of the studies done by Bao et al [17] and some aspects of Letchumanan et al [27] study. Letchumanan et al [27] study, conducted to evaluate the radiographic patterns of Covid-19 using chest radiographs, reported that the distribution of the lung abnormality showed more peripheral distribution, which is in agreement with our finding. Nevertheless, Letchumanan et al [27] study, reported unilateral lung involvement, which is inconsistent with our findings. The differences in our findings could be ascribed to the nature of our different studies.

In this study, we found that the cases with all the lobes affected were highest. This is in agreement with the finding of the study conducted by Chung et al [16], which also reported that those with all the lobes affected were highest.

The characteristics of the GGO were also documented in our study, we found that the most common characteristic was crazy-paving, which is thickened interlobular septa superimposed on GGO. This finding is in harmony with the finding of the study carried out by Guan et al [19], which also reported crazy-paving as the most common feature of the GGO.

Our study is not without limitations. Firstly, the relatively small sample size for this study may not be representative. The limited sample size can be explained because most patients avoided the hospital as they deferred care for life-threatening conditions and PT-PCR assay was not readily available. Secondly, follow-up CT imaging to evaluate

treatment efficacy to substantiate the diagnosis was not done. Thirdly, chest radiographs were not reviewed and lastly, our study was a retrospective study, in which only CT imaging findings were evaluated.

Conclusion:-

The commonest chest CT appearance of covid-19 pneumonia is bilateral GGO with a predilection for the lower lobes of the lungs. Other findings may include crazy paving, reverse halo sign, and hazy patchy densities. The findings of this study are consistent with findings described in the literature, given the fact that GGO with bilateral and peripheral distributions have been considered the hallmark of COVID-19. Radiologists and clinicians should take cognizance of imaging appearances and diagnostic capabilities of Chest CT in covid-19 pneumonia, especially in the context of the current pandemic.

Conflict of interest

There was none declared among the authors

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