

# Covid-19 pandemic: profile of the affected and protagonism of computerized tomography in sars-cov-2 pneumonia

Pandemia covid-19: perfil dos acometidos e protagonismo da tomografia computadorizada na pneumonia por sars-cov-2

Pandemia covid-19: perfil del afectado y protagonismo de la tomografía computarizada en neumonía por sars-cov-2

## RESUMO

**Objetivo:** analisar o papel da tomografia computadorizada de tórax na avaliação do acometimento populacional por pneumonia durante a pandemia de COVID-19, em 2020. **Método:** Trata-se de um estudo retrospectivo onde foram analisados os laudos e imagens de 103 pacientes, internados no período de 01 a 30 de abril de 2020, com suspeita de pneumonia por COVID-19, Fortaleza, Ceará. **Resultado:** O quantitativo de pacientes que apresentaram imagens sugestivas para COVID-19 foi de 65% dos pacientes admitidos. A média geral de idade dos pacientes com tomografia positiva para infecção foi de 58,68 anos. Os principais achados descritos em laudos analisados foram: padrão de vidro fosco em 97,01% dos casos, consolidações parenquimatosas em 13,43%, estrias em 29,85% e derrame pleural em 4,47% dos pacientes examinados. **Conclusão:** A tomografia computadorizada de tórax demonstra protagonismo como ferramenta diagnóstica e tem sido determinante para o isolamento e monitoramento de grande parcela dos pacientes infectados.

**DESCRIPTORIOS:** Pandemia; Tomografia Computadorizada; Tórax; Covid-19.

## ABSTRACT

**Objective:** this study aimed to analyze the role of thoracic computed tomography in the evaluation of the involvement of the population with pneumonia during the COVID-19 pandemic in 2020. **Method:** This is a retrospective study in which the reports and images of 103 patients hospitalized from April 1 to 30, 2020, with suspected COVID-19 pneumonia, in Fortaleza, Ceará, were analyzed. **Result:** The number of patients who presented images suggestive of COVID-19 was 65% of hospitalized patients. The overall mean number of patients with positive tomography for infection was 58.68 years. The main findings described in the analyzed reports were: ground glass pattern in 97.01% of the cases, parenchymic consolidations in 13.43%, stretch marks in 29.85% and pleural effusion in 4.47% of the patients examined. **Conclusion:** Computed tomography of the chest is a highlight as a diagnostic tool and has been decisive for the isolation and follow-up of most infected patients.

**DESCRIPTORS:** Pandemic; Computed tomography; Thorax; Covid-19.

## RESUMEN

**Objetivo:** Este estudio tuvo como objetivo analizar el papel de la tomografía computarizada del tórax en la evaluación de la afectación de la población por neumonía durante la pandemia de COVID-19 en 2020. **Método:** Se trata de un estudio retrospectivo en el que se analizaron los informes e imágenes de 103 pacientes hospitalizados del 1 al 30 de abril de 2020, con sospecha de neumonía por COVID-19, Fortaleza, Ceará. **Resultado:** El número de pacientes que presentaron imágenes sugestivas para COVID-19 fue del 65% de los pacientes ingresados. La edad media global de los pacientes con tomografía positiva para la infección fue de 58,68 años. Los principales hallazgos descritos en los informes analizados fueron: patrón de vidrio mate en el 97,01% de los casos, consolidaciones parenquimatosas en el 13,43%, estrias en el 29,85% y derrame pleural en el 4,47% de los pacientes examinados. **Conclusión:** La tomografía computarizada del tórax demuestra protagonismo como herramienta diagnóstica y ha sido determinante para el aislamiento y seguimiento de una gran parte de los pacientes infectados.

**DESCRIPTORIOS:** Pandemia; Tomografía Computarizada; Tórax; Covid-19.

RECEBIDO EM: 17/05/2021 APROVADO EM: 30/08/2021

## REGINA PAULA SOARES DIEGO

Technical coordinator at Clínica Omnimagem and doctoral student at PPG Pharmaceutical Sciences at UFC. Teacher. Bachelor of Biomedicine.

ORCID: 0000-0002-9606-0598

## LINDENBERG BARBOSA AGUIAR

Radiologist doctor. Omnimagem Clinic. Bachelor of Medicine

ORCID: 0000-0002-9592-7006.

## ISABELLE BERNARDINA DA SILVA LOPES

Biomedical Imagenologist at Clínica Omnimagem. Bachelor of Biomedicine

ORCID: 0000-0003-3329-524X.

## EVEANIA ARAÚJO COELHO DO NASCIMENTO

Radiology Technologist at Clínica Omnimagem. Specialist. Bachelor of technologist in radiology

ORCID: 0000-0003-1532-1280.

## JEFESSON RODRIGUES DE ALMEIDA

Student at Unifanor-Wyden. Graduating in Biomedicine

ORCID: 0000-0002-2188-0057.

## GANDHI RÁDIS BAPTISTA

Associate Professor at the Federal University of Ceará (UFC) and advisor of the postgraduate program in Pharmaceutical Sciences at UFC, Member of the American Chemical Society (American Chemical Society, ACS). Doctor. Bachelor in Biochemical Pharmacy

ORCID: 0000-0001-9210-092X.

## INTRODUCTION

In December 2019, cases of severe pneumonia of unknown cause were reported in Wuhan, Hubei Province, China. A new strain of coronavirus belonging to the same family of viruses that causes severe acute respiratory syndrome (SARS) and Middle Eastern respiratory syndrome (MERS), as well as the 4 human coronaviruses associated with the common cold, was subsequently isolated from the lower respiratory tract of 4 case samples on January 7th, 2020. 1 The pandemic originated in the province of Hubei, China, spread to more than 215 countries, surpassing, at the end of April 2020, 3.25 million infected people and 230 thousand deaths. Viral infection, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), may be asymptomatic or may result in mild to severe symptomatic disease (COVID-19). 2,3

The National Health Commission of the People's Republic of China, in February 2020, launched the 5th edition of the "Diagnosis and Management Plan for New Coronavirus Pneumonia" and highlighted

the role of Computed Tomography (CT) in Hubei Province to promote early detection and isolation. CT may play a more important role in the management of patients with COVID-19, from diagnosis to qualitative and quantitative monitoring. 4

Chest images were used to monitor patients, demonstrating the evolution of pneumonia, providing clear and dynamic information about lung lesions, including multiplanar and three-dimensional volumetric reconstructions. 5,6 The exam can also provide quantitative information, including percentage of involvement by lesions and mean density values of the lung parenchyma. 7,8

The typical findings of pneumonia caused by COVID-19 are nonspecific, as well as for other pulmonary infections, in addition to varying according to the clinical stage of the disease in each individual. 9 Therefore, the pattern found in the images must always be correlated with clinical symptoms and laboratory results. The definitive diagnosis of the disease must be confirmed using the RT-PCR test. 9,10

Tomographic manifestations of CO-

VID-19 pneumonia generally are presented by a lesion that originates from a round nodule in the center of the secondary lung lobe, which is usually shown as round ground-glass opacity at onset, later extending to all secondary lung lobes, forming irregular lobular images. 11,10 Inflammatory stimulation leads to thickening of the lesion's blood vessels, which results in corresponding changes seen on the images. 10

Studies have shown that computed tomography plays a leading role in the early diagnosis and follow-up of pulmonary involvement by COVID-19. 12. Through what was mentioned above, this study aimed to analyze the main characteristics of the population involvement by pneumonia of viral etiology Sars-Cov-2 during the COVID-19 pandemic, in the city of Fortaleza - Ceará, in 2020.

## METHODS

The present study is characterized as a descriptive and retrospective survey with a quantitative approach, as it gathers data on the results verified in image analysis and

examination reports, Computed Tomography of the Chest of patients coming from the emergency service, who underwent exams for the diagnosis, staging and monitoring of response-treatment of pneumonia caused by COVID-19, in the period from April 1st to 30th, 2020.

The sample consisted of tomographic images of the chest of 103 patients. For the composition of the sample, the following inclusion criteria were considered: images of patients of both sexes and of any age, with suspected diagnosis of pneumonia caused by COVID-19, referred by the emergency center attached to the aforementioned radiology service, with medical request to perform a chest computed tomography during the month of April 2020. Images of patients who did not meet the previously reported inclusion criteria were excluded.

This research was carried out within the computerized tomography service of Clínica Omnimagem, located in the city of Fortaleza – Ceará. All images were acquired without the need for administration of contrast media. For this procedure, a 32-channel Multislice Canon/Toshiba

Computed Tomography equipment Canon/Toshiba Model Alexion (TOSHIBA Medical do Brasil Ltda), duly calibrated and approved for clinical use was used.

Data analysis was performed using the PAD PRISM version 5.0 software, where the images acquired and the most relevant findings demonstrated in the reports issued by the service were approached using descriptive statistics resources of a univariate nature, including frequency measures. The instrument used for data collection was the Picture Archiving and Communication System database (PACS System), through which we will retrieve the images of patients admitted under emergency care.

To compose the theoretical framework of this work, a search was performed for articles published in the main scientific databases (CAPES periodicals, PUBMED, Google Scholar), between 2020 and 2021, using the keywords "Computerized Tomography", "Thorax" and "COVID-19".

A waiver from the application of the Informed Consent Term - TCLE was requested because it is a retrospective research based on images filed in the database of the transferring clinic. The project of this research

was submitted to the Ethics Committee 5054 - UFC - Federal University of Ceará / PROPESQ-UFC, via Plataforma Brasil, under CAAE nº 51471221.5.0000.5054 and Protocol nº 101954/2021. During the entire research process, especially in the information gathering phase, all ethical precepts established in Resolution No. 466/12 of CNS/MS/BRASIL were respected.

## RESULTS

A total of 103 patients were admitted, with a mean age of 55,87 years, from the emergency department of the Central Hospital of Fortaleza for a chest computed tomography exam during the month of April 2020 (first wave of the COVID-19 pandemic), among which 57 were men, comprising 55.30% of the individuals examined and 46 were women (44,70%).

The number of patients who presented images suggestive of COVID-19 was 67, corresponding to 65% of the total number of patients admitted during that period. The overall mean age of patients with positive tomography for infection was 58.68 years and 58% of patients with positive tomography for pneumonia were men (39).

The main findings described in the computed tomography reports of the chest analyzed were: Ground Glass Pattern in 97,01% of the cases, Parenchymal Consolidations in 13,43 % of the exams, Stretch Marks in 29,85% and Pleural Effusion in 4,47% of the examined patients (Table 1)

The lesions found in the lung parenchyma showed a peripheral pattern in 53,73% of cases (36 patients), with bilateral involvement of the lungs in 56 exams, corresponding to 83,58% of all positive cases observed on chest computed tomography, as shown in Figure 1.

In 88,05% of the affected patients (59), involvement of the lower lung lobes was observed, while the involvement of the upper lung lobes was detected in 64,17% of the positive patients (43) for the infection.

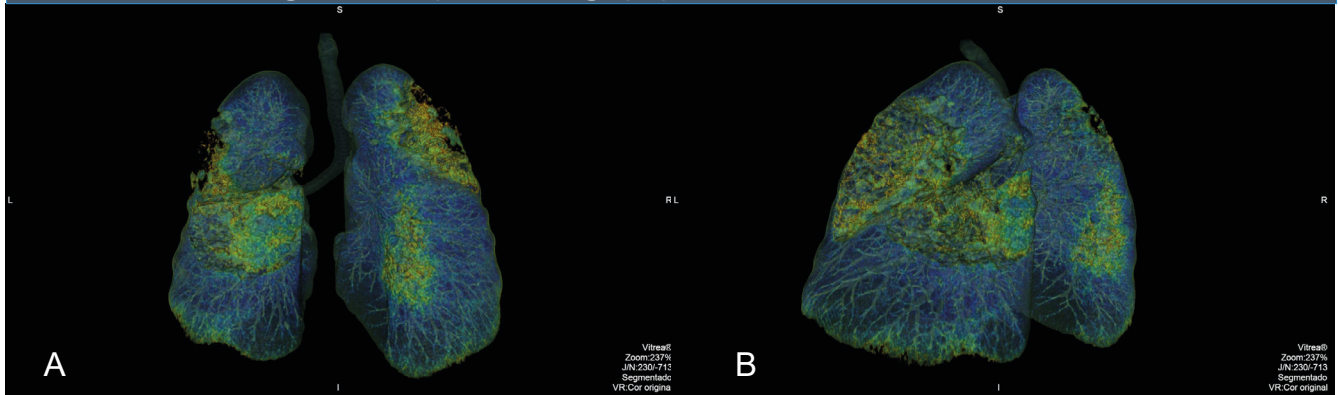
The observation of sparse contents in the lung parenchyma was described in 34 computed tomography reports of the chest positive for pneumonia of probable viral

Tabela 1. Principais achados descritos nos laudos médicos de pacientes encaminhados do serviço de emergência, em Fortaleza, Ceará, 2020.

FINDINGS DESCRIBED IN REPORT	NUMBER OF PATIENTS WHO PRESENTED THE CHANGE	PATIENTS WITH THE REFERRED PATTERN AMONG INFECTED INDIVIDUALS (%)
Frosted Glass Pattern	65	97,01
Parenchymal Consolidations	09	13,43
Presence of Stretch Marks	20	29,85
Pleural effusion	03	04,47

Source: Survey data, 2021.

Figure 1. Computed tomography of the chest - 3D reconstruction



Source: Survey data, 2020. (A and B) Examples of Computed Tomography Chest images of patients suspected of being infected by COVID-19. Three-dimensional reconstruction showing parenchymal lesions (yellow areas) of predominantly peripheral pattern (ground-glass pattern opacities) with bilateral involvement of the lungs.

Figure 2. Computerized Chest Tomography Examination



Source: Research data, 2020. High Resolution CT images of the chest in coronal (A) and axial (B) planes showing parenchymal consolidations (arrows) in the posterior lung region, bilaterally.

Figure 3. Computerized Chest Multiplanar Tomography



Source: Research data, 2020. CT images of the chest in coronal (A) and axial (B) planes demonstrating ground-glass pattern opacities (arrows) in the lung parenchyma, bilaterally

cities of rounded morphology, predominantly in the peripheral regions of the lung lobes and in posterior regions, often at the bases. 12

The involvement by COVID-19 is, in most cases, multilobar and bilateral. In

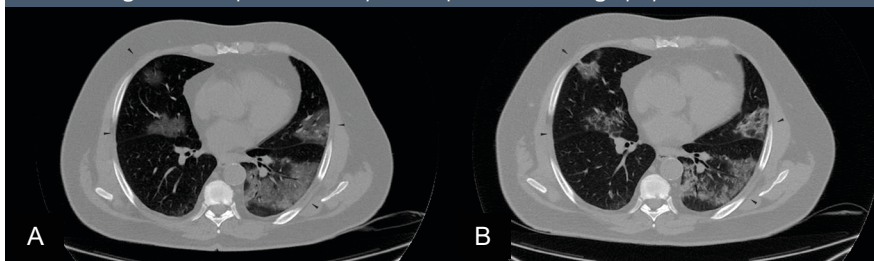
is usually evidenced, suggesting a worse prognosis. 13,7 Followed by ground-glass opacity, consolidation is the second most common alteration found in pneumonia caused by COVID-19, establishing itself in later stages of the infection, however, both

alterations can manifest themselves concomitantly. Consolidations are represented by the filling of the pulmonary alveoli with inflammatory exudate, characterizing an increase in pulmonary density, with obscuration of blood vessels and their interstices. 7,12,13

Similar aspects on computed tomography scans have been reported, with a predominance of vesicular lesions, usually with bilateral and multifocal involvement, peripheral distribution and predominance in the middle-inferior and posterior lung regions.13 Septal thickening and reticular lesions superimposed on alveolar lesions that reflect the concomitant interstitial involvement have also been described, especially in patients at a more advanced stage of the disease. Early scarring lesions in the lungs (fibrotic streaks) and pleural effusion are also present in later stages of the pathology. 7,8,14

Among all patients undergoing the examination, most had confirmation of pneumonia of probable viral etiology (65% of patients) and the mean age of these patients was 58,68 years, a rate slightly below the age indicated in the literature as a target population for the etiology (public over 60 years). The predominance of males demonstrates that men tend to be more likely to develop the disease, as according to Soares, 15 this may be linked to an unhealthy lifestyle, associated with smoking and

Figure 4. Comparative Study of Computerized Tomography of the Chest



Source: Research data, 2020. CT images of the chest in the axial plane (male patient aged 65 years) acquired on 04/09/2021 (A) and 04/15/2021 (B) showing improvement in the condition of pneumonia of viral etiology upon evidence of regression of lesions (arrows).

alcoholism, in addition to the neglect of social isolation and preventive practices.

A ground-glass pattern was observed in 97,0% of positive chest CT images (Figure 2), while parenchymal consolidations were reported in only 13,43% of cases and pleural effusion in 4,47% of these exams (Figure 3). These findings demonstrate the great sensitivity of computed tomography in the early detection of the disease, showing

changes in early pneumonia caused by SARS-CoV-2.

Computed tomography has allowed, through the correlation of periodically acquired chest images, the monitoring of patients and the verification of the evolution of the clinical picture and response to treatment (Figure 4).

## CONCLUSION

Although the diagnosis of COVID-19 is confirmed only through the RT-PCR test, computed tomography of the chest demonstrates its role as an available diagnostic tool and has been crucial for the isolation and monitoring of a large number of infected patients. Together with the radiological findings, understanding the population profile of those affected by Sars-Cov-2 has demonstrated its importance in the context of collective and epidemiological health, as the prevalence of those affected by the virus tends to change with the course of their mutations.

It is of fundamental importance that the teams involved in the care of patients in radiodiagnostic centers recognize the radiological findings suggestive of viral pneumonia compatible with COVID-19, thus contributing to the isolation of individuals affected by the pathology and consequently collaborating to contain the spread of the SARS-CoV-2.

## REFERENCES

- Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR et al. The Incubation Period of Coronavirus Disease 2019. *Ann Intern Med* 2020;172(9):577-582. DOI: 10.7326/M20-0504.
- Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID 19) outbreak in china: summary of a report of 72 314 cases from the chinese center for disease control and prevention. *JAMA*. 2020;323(13): 1239-1242. DOI:10.1001/jama.2020.2648
- Xu Z, Shi L, Wang Y, et al. Pathological findings of COVID 19 associated with acute respiratory distress syndrome. *Lancet Respir Med*. 2020;8(4): 420-422. DOI: 10.1016/S2213-2600(20)30076-X.
- Qi, Xiaolong, Junqiang L, Qian Y, et al. CT imaging of coronavirus disease 2019 (COVID-19): from the qualitative to quantitative. *Annals of translational medicine*, vol. 8,5 2020;256. DOI: 10.21037/atm.2020.02.91
- Fauci AS, Lane HC, Redfield RR. Covid-19 - Navigating the Uncharted. *N Engl J Med*. 2020; 382:1268-1269. DOI: 10.1056/NEJMe2002387
- Qin C, Liu F, Yen TC, et al. 18F-FDG PET/CT findings of COVID-19: a series of four highly suspected cases. *Eur J Nucl Med Mol Imaging*, 2020;47(5):1281-1286. DOI: 10.1007/s00259-020-04734-w
- Romano L, Pinto A, Merola S, et al. Intensive-care unit lung infections: The role of imaging with special emphasis on multi-detector row computed tomography. *Eur J Radiol*, 2008;65(3):333-9. DOI: 10.1016/j.ejrad.2007.09.018
- Zu ZY, Jiang MD, Xu PP, et al. Coronavirus Disease 2019 (COVID-19): A Perspective of China. *Radiology*, 2020: 200-490. Disponível em: <https://doi.org/10.1148/radiol.2020200490>
- Kanne JP, Little BP, Chung JH, et al. Essentials for Radiologists on COVID-19: An Update-Radiology Scientific Expert Panel. *Radiology*. 2020; 200-527. Disponível em: <https://doi.org/10.1148/radiol.2020200527>
- Araújo-Filho JAB, Sawamura MVY, Costa AN, et al. Pneumonia por COVID-19: qual o papel da imagem no diagnóstico?. *J Bras Pneumol*, 2020;46(2):2020-0114. Disponível em: <https://dx.doi.org/10.36416/1806-3756/e20200114>
- Meng H, Xiong R, He R, et al. CT imaging and clinical course of asymptomatic cases with COVID-19 pneumonia at admission in Wuhan, China. *The Journal of infection*, 2020;81(1), 33-39. DOI: 10.1016/j.jinf.2020.04.004
- Rosa MEE, Matos MJR, Renata Furtado SOP, Brito VM, Maral, LTW, Beraldo GL, et al. Achados da COVID-19 identificados na tomografia computadorizada de tórax: ensaio pictórico. *Einstein*, 2020;18. DOI: 10.31744/einstein\_journal/2020RW5741
- Song F, Shin N, Shan F, et al. Emergindo 2019 Novel Coronavirus (2019-nCoV) Pneumonia. *Radiology*, 2020:200-274. Vol. 295, No. 1. Disponível em: <https://doi.org/10.1148/radiol.2020200274>
- Zhou S, Wang Y, Zhu T, et al. CT Features of Coronavirus Disease 2019 (COVID-19) Pneumonia in 62 Patients in Wuhan, China. *AJR Am J Roentgenol*. 2020; 214(6):1287-1294. DOI: 10.2214/AJR.20.22975
- Soares, AJ, Soares, CFS, Santos Silva, FC, Ferreira da Silva, A, Estrela, FM, Magalhães, JRF, et al. Elementos da masculinidade que vulnerabilizam homens à morbimortalidade pela COVID-19: revisão integrativa. *Saúde Coletiva*, 2021; 11 (N)65. DOI: <https://doi.org/10.36489/saudecoletiva.2021v11i65p5926-5939>