Comparative analysis of radiological changes in SARS-CoV AND SARS-CoV-2 viruses: a literature review

Análise comparativa sobre as alterações radiológicas ocasionadas pelos vírus SARS-CoV e SARS-CoV-2: uma revisão de literatura

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ABSTRACT: In late 2019 a new coronavirus called SARS-CoV-2 appeared in Wuhan, China and was responsible for a pandemic with unprecedented repercussions. However, it is known that the country had an epidemic of another coronavirus called SARS-CoV about 20 years ago in 2002, and its carriers presented a very similar clinical picture to those infected by the new virus. In addition to the clinical picture, the radiological presentation is also generally similar. Thus, the present study aims to analyze and compare the radiological changes present in both infections, as well as the scientific production about these findings, through a literature review. The research for theoretical framework occurred in August 2020 through the Scielo, Medscape and PubMed databases, in addition to medical protocols. After applying the inclusion and exclusion criteria, a total of 21 articles and six protocols were selected which met the study's objective. The radiological changes of SARS-CoV and SARS-CoV-2 are indeed generally similar, although there are some differences in relation to virulence and the degree of progression of pulmonary involvement. As for the best imaging method, radiography stands out as a cheaper and more accessible tool, taking into account health service overload in a worldwide pandemic context.

Keywords: COVID 19; Infection coronavirus; Radiography; Computed tomography.

RESUMO: No final de 2019 um novo coronavírus denominado SARS-CoV-2 surgiu em Wuhan, na China e foi responsável por uma pandemia com repercussões sem precedentes. Entretanto, sabe-se que há cerca de 20 anos, em 2002, o país teve uma epidemia de outro coronavírus, o SARS-CoV, sendo que seus portadores apresentaram quadro clínico muito semelhante aos infectados pelo novo vírus. Além da clínica, a apresentação radiológica, de maneira geral, também é similar. Dessa forma, o presente estudo tem como objetivo a análise e comparação das alterações radiológicas presentes em ambas as infecções, bem como a produção científica acerca desses achados, por meio de uma revisão da literatura. A busca pelo referencial teórico ocorreu em agosto de 2020 por meio das bases de dados da Scielo, Medscape e PubMed, além de protocolos médicos. Após aplicação dos critérios de inclusão e exclusão foram selecionados vinte e um artigos que atenderam o objetivo da pesquisa e cinco protocolos. As alterações radiológicas do SARS-CoV e SARS-CoV-2 são, de forma geral, semelhantes, embora, há algumas diferenças, em relação a virulência e ao grau de progressão do acometimento pulmonar. Quanto ao melhor método de imagem, a radiografia pode se sobressair como uma ferramenta mais barata e acessível, levando em consideração a sobrecarga dos serviços de saúde no contexto de uma pandemia mundial.

Palavras-chave: COVID 19, Infecções por coronavírus; Radiografia; Tomografia computadorizada.

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INTRODUCTION

COVID-19 disease was first recorded in China in late 2019 in Wuhan city, caused by the new SARS-CoV-2 coronavirus, and quickly became a public health problem when its pandemic was declared in March 2020[1,2,3]. A similar species of coronavirus (SARS) had previously been identified, responsible for a previous outbreak of severe acute respiratory syndrome[4]. According to data from the World Health Organization (WHO), the SARS-CoV infection affected 26 countries, and was responsible for 5,327 cases and 774 deaths[5]. On November 29, 2020, an information sheet also by the WHO was posted which registered 60,534,526 cases of COVID-19 and 1,426,101 deaths in the world[6].

Infection by SARS-CoV epidemiologically predominates in adults between 25 and 70 years old, being uncommon in children[7]. Its main form of transmission is oral, nasal or mucosal contact and transmission via coughing, sneezing or respiratory droplets[8]. Its clinical picture begins with non-specific prodromal symptoms such as fever, chills, headache, myalgia and respiratory symptoms. Contrary to what is observed in COVID-19 disease, clinically asymptomatic cases were not registered[7,9].

Infection caused by SARS-CoV-2 generally does not affect a predominant age group. Since its transmission is similar to that of SARS-CoV, COVID-19 usually presents as a mild disease or even asymptomatic[9]. The main symptoms are: fever, coughing, dyspnea, rhinorrhea and myalgia[10]. However, it can progress to a more severe stage in some risk groups such as patients with comorbidities and older adults, characterized by respiratory failure and even death[9].

The diagnosis of infections caused by coronaviruses is broad and can be considered from the clinical history, laboratory tests and radiological tests. The Polymerase Chain Reaction (PCR) exam added to clinical and epidemiological data is the gold standard for the diagnosis of COVID-19[11]. A radiological study makes it possible to recognize the presentation patterns of the disease, which is essential to understand its pathophysiology and natural history, in addition to predicting the progression and risk of future complications[10].

OBJECTIVE

To establish a comparison of the radiological presentation of infections caused by the SARS-CoV virus and SARS-Cov-2.

METHOD

The present study consists of a literature review regarding radiological alterations in SARS-CoV and SARS-Cov-2. Articles were selected from the SciELO, Medscape and PubMed databases. The search was carried out during the month of August 2020 with the following descriptors: "SARS-CoV", "SARS-CoV-2", "COVID-19" and "radiographic findings". Studies in Portuguese, English and Spanish published between 2000 and August 2020 were considered.

As inclusion criteria, original articles which addressed the research topic and allowed full access to its content were considered, excluding those that did not meet the aforementioned inclusion criteria and repeated studies in the three platforms. Exclusion criteria were: editorials; opinion texts; rapid-communication; experience reports.

The search in the databases was carried out separately by two researchers, each selecting articles according to pre-established criteria. Then, the studies selected by each one were analyzed, and finally 21 articles were selected from this compilation for consideration in the present study.

The search on the platforms resulted in 70 identified articles adding the three databases, and 16 were excluded for being duplicates. After analyzing the title and abstract, 26 articles were excluded due to thematic incompatibility. After reading the articles in full, 21 were selected for descriptive analysis, as shown in the flowchart 1.
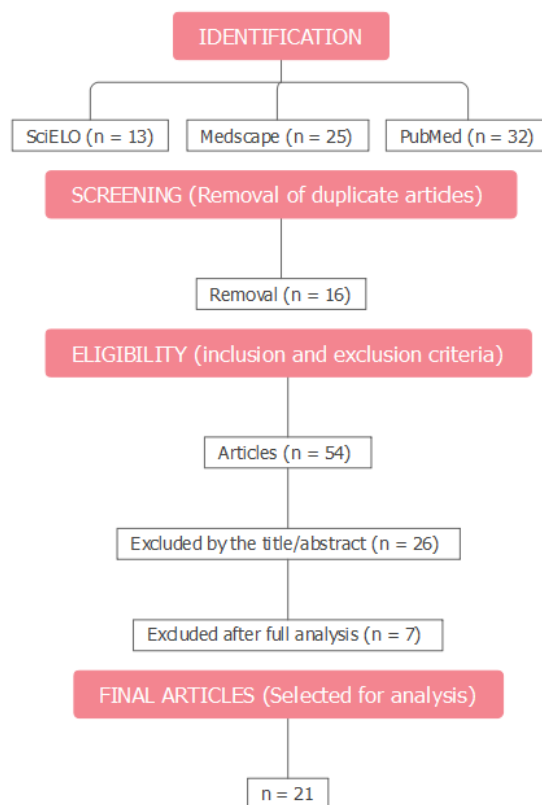
Source: The authors, 2020.

Flowchart 1 – Selected for descriptive analysis

Medical protocols were additionally consulted, aiming to cover the guidelines given by medical societies and by the governmental health agency. These include: Guide of the Brazilian College of Radiology on Recommendations for the Use of Imaging Methods for Patients Suspected of Infection by COVID-19, Guide of the Brazilian College of Radiology Indication and Interpretation of Imaging Findings in COVID-19, Guidelines on Diagnosis, Treatment and Isolation of Patients with COVID-19 from the COVID-19 Collaborative Force Group Brazil, Clinical Management Protocol for the New Coronavirus of the Ministry of Health

and WHO Guidelines for the global surveillance of severe acute respiratory syndrome (SARS).

RESULTS

After applying the inclusion and exclusion criteria, 21 articles were selected that met the research objective. The list of articles and medical protocols used with general data and their correlation with the theme of this study is shown below in Table 1 for a better visualization.

Table 1 – List of articles with general data

ID	TITLE	AUTHORS	YEAR	COUNTRY	RESULTS
1	Clinical course and management of SARS in health care workers in Toronto: a case series.	Avendano et al.[17]	2003	Canada	There is a direct relationship between dyspnea severity and radiological findings for **SARS-CoV** virus
2	Evaluation of WHO criteria for identifying patients with severe acute respiratory syndrome out of hospital: prospective observational study.	Rainer et al.[16]	2003	China	All patients had changes in the chest X-ray for the **SARS-CoV** virus, most of them at the beginning of the disease.
3	Severe Acute Respiratory Syndrome (SARS): *A primeira doença grave transmissível do séc. XXIX*.	Correia; Albuquerque[7]	2004	Brazil	There is the appearance of non-specific changes in the chest X-ray for the **SARS-CoV** virus from 3 to 7 days after the onset of symptoms.
4	WHO guidelines for the global surveillance of severe acute respiratory syndrome (SARS).	World Health Organization et al.[5]	2004	WHO	WHO reports criteria for suspicion and diagnosis of **COVID-19**, including radiographic criteria (lung infiltrates indicative of pneumonia).
5	Pneumonia por COVID-19: qual o papel da imagem no diagnóstico?	Araujo-Filho et al.[19]	2020	Brazil	Chest radiography is not a first-line modality in COVID-19, and chest CT is the most sensitive.
6	Protocolo de manejo clínico para o novo-coronavírus.	Brasil. Ministério da Saúde.[4]	2020	Brazil	Presentation of the **COVID-19** clinical management protocol by the Ministry of Health in Brazil.
7	Chest CT features of coronavirus disease 2019 (COVID-19) pneumonia: key points for radiologists.	Carotti et al.[11]	2020	Italy	Chest CT is an excellent diagnostic tool for **COVID-19**, being effective in detecting the disease even in the absence of symptoms.
8	Apresentação tomográfica da infecção pulmonar na COVID-19: experiência brasileira inicial.	Chate et al.[1]	2020	Brazil	Chest radiography is useful in monitoring **COVID-19**, as it is a fast, inexpensive and widely available method.
9	Pneumonia por COVID-19 e o sinal do halo invertido.	Farias et al.[13]	2020	Brazil	The inverted halo sign is a common radiological finding in **SARC-CoV-2** infection.
10	Recomendações de uso de métodos de imagem para pacientes suspeitos de infecção pelo COVID-19.	Radiologia, CBR[2]	2020	Brazil	Chest radiography helps in **COVID-19** cases of bedridden patients or patients unable to perform chest CT.
11	Achados de imagem na COVID-19 Indicação e interpretação.	Radiologia, CBR[3]	2020	Brazil	Chest tomography should not be used in screening for **SARC-CoV-2**.
12	Orientações sobre Diagnóstico, Tratamento e Isolamento de Pacientes com COVID-19.	Dias et al.[12]	2020	Brazil	Pleural effusion is a very common tomographic finding in patients infected with **COVID-19**.

Table 1 – List of articles with general data   *continuation*

ID	TITLE	AUTHORS	YEAR	COUNTRY	RESULTS
13	Imaging findings in COVID-19 pneumonia.	Farias et al.[22]	2020	Brazil	Chest X-ray has low sensitivity and chest CT has high sensitivity for **SARC-CoV-2.**
14	Return of the Coronavirus: 2019-nCoV.	Gralinski, Lisa E.; Menachery, Vineet D.[18]	2020	The United States	**SARS-CoV-2** appears to be less virulent than its predecessor; this fact is reflected in radiological manifestations, which are more frequent and more severe in **SARS-CoV.**
15	Three emerging coronaviruses in two decades: the story of SARS, MERS, and now COVID-19.	Guarner, Jeannette.[21]	2020	Georgia	The lethality of **SARS-CoV** is greater than that of its successor; however, **SARS-CoV-2** will cause more deaths due to the greater spread of the disease.
16	Emerging coronaviruses: first SARS, second MERS and third SARS-CoV-2: epidemiological updates of COVID-19.	Halaji et al.[8]	2020	Iran	The authors present the epidemiological updates of **SARS-CoV** and **SARS-CoV2** epidemics.
17	Severe acute respiratory syndrome: historical, epidemiologic, and clinical features.	Hui, David SC; Zumla, Alimuddin.[14]	2020	China	Common radiographic presentation of **SARS-CoV** and **SARS-CoV2**, with peribronchial thickening and ground-glass opacification.
18	Informações sobre o novo coronavírus (COVID-19).	Lima, Claudio M. Amaral O.[10]	2020	Brazil	Pulmonary radiological changes in **COVID-19** appear 10 days after the onset of symptoms.
19	Studies on viral pneumonia related to novel coronavirus SARS-CoV-2, SARS-CoV, and MERS-CoV: a literature review.	Liya, Guo et al.[9]	2020	China	Common radiographic presentation of **SARS-CoV** and **SARS-CoV2**, with initial limited lesions and dominant ground-glass opacity appearance.
20	Chest radiography and computed tomography findings from a Brazilian patient with COVID-19 pneumonia.	Moreira et al.[27]	2020	Brazil	Common radiographic presentation of **SARS-CoV** and **SARS-CoV2** with pulmonary opacities.
21	COVID-19-Computed tomography findings in two patients in Petrópolis, Rio de Janeiro, Brazil.	Muniz et al.[20]	2020	Brazil	Chest radiography is not sensitive for early detection of the disease, so it is not recommended as a first choice in **COVID-19.**
22	Diagnóstico de pacientes con sospecha de COVID-19:¿ Cuál es el rol de la TC de tórax?	Páez-Granda et al.[24]	2020	Ecuador	Chest radiography has low sensitivity in the initial phase of **COVID-19**, unlike chest CT, which can demonstrate pathological findings early.
23	SARS-CoV-2, SARS-CoV, and MERS-CoV: a comparative overview	Rabaan et al.[15]	2020	Saudi Arabia	The authors contrast the epidemiology and clinical presentation of epidemics caused by **SARS-CoV** and **SARS-CoV2.**
24	La radiología en el diagnóstico de la neumonía por SARS-CoV-2 (COVID-19).	Sánchez-Oro et al.[27]		Spain	The use of chest X-ray is limited in the study of **COVID-19**, and on the other hand, it is possible to identify pathological findings on chest CT in the same time frame.
25	Frequency and distribution of chest radiographic findings in COVID-19 positive patients.	Wong et al.[25]	2020	China	Chest CT is the gold standard test to assess pulmonary involvement in **COVID-19.**
26	Chest radiographic and CT findings of the 2019 novel coronavirus disease (COVID-19): analysis of nine patients treated in Korea.	Yoon et al.[23]	2020	South Korea	Chest X-ray has limitations for the analysis of pulmonary involvement in **COVID-19**, as most lesions are ambiguous and non-specific.

Source: The Authors, 2020.

DISCUSSION

SARS virus history

Severe Acute Respiratory Syndrome (SARS) is considered the first serious communicable disease of the 21st century, characterized by an acute respiratory disease that can progress to severe pneumonia[7]. The first known case of SARSs occurred in 2002 in Foshan City, China. In March 2003, the World Health Organization (WHO) issued a warning about the spread of cases of severe atypical pneumonia, later called SARS (Severe Acute Respiratory Syndrome). Then, the etiological agent was identified: a new virus of the Coronavirus family (SARS-CoV). Finally, control of the SARS epidemic was declared in July 2003, accounting for 8098 cases and 774 deaths, covering 26 countries[7]. Since then, there has been no other outbreak of disease caused by the virus in this family to date[12].

Then, an outbreak of highly contagious pneumonia of unknown etiology was reported in Wuhan City, China, in December 2019, with many infected patients presenting severe acute respiratory syndrome (SARS). It quickly spread to other countries and was declared a pandemic in March 2020 by the WHO. The etiologic agent identified was a coronavirus (SARS-CoV-2) and the infection was respectively called Coronavirus 2019 disease (COVID-19)[13].

The Coronaviridae family is so called due to the shape of its viruses, as they resemble that of a crown when viewed under microscopy[10]. They are single-stranded RNA viruses capable of causing respiratory infections, ranging from common colds to bronchiolitis and pneumonia. Seven strains are known thus far, with the most important being: SARS-CoV (causing severe acute respiratory syndrome), MERS-CoV (causing Middle Eastern respiratory syndrome) and SARSCoV-2, a new coronavirus which causes COVID-19[8].

SARS-CoV

SARS is a respiratory disease which initially presents fever, headache, myalgia, and fatigue. Lower respiratory tract affection signs appear from 3 to 7 days after the onset of symptoms with dry cough and dyspnea, which can progress to hypoxemia, and in some cases to severe respiratory failure[7]. The main transmission mode of SARS-CoV is through close contact with an infected person via droplets from the carrier's cough or sneeze. The pathogenesis of SARS-Cov is complex and not fully defined[14]. However, it is known that the main target cells are pneumocytes in the pulmonary epithelium, especially affecting dendritic cells and macrophages, producing pro-inflammatory cytokines[15].

SARS-CoV radiological alterations

Radiology is essential for evaluating patients with SARS-CoV, and chest radiography is the first diagnostic method of choice. Rainer et al.[16] point out that radiological changes in the chest had the highest probability ratio of all clinical predictors, present in almost 75% of the patients followed.

The chest X-ray may be normal at the beginning or even throughout the course of the disease; however, in most cases, there is the appearance of non-specific changes from 3 to 7 days after the onset of symptoms, which may start with a peripheral unilateral lesion, which progresses to multiple or ground-glass opacity lesions[7,17].

The most common findings are: scattered focal infiltrates, which can converge and become diffuse, single or multiple alveolar space pneumonia foci, predominantly in the lung bases and in some cases extending to the middle areas and sparing the superior lobes. Finally, parenchymal consolidation areas may appear in the more advanced stages of the disease[7].

Figure 1. Chest X-ray (PA) showing opacities in the lower right third and middle and lower left thirds (**Source**: Hui, David SC; Zumla, Alimuddin[14])
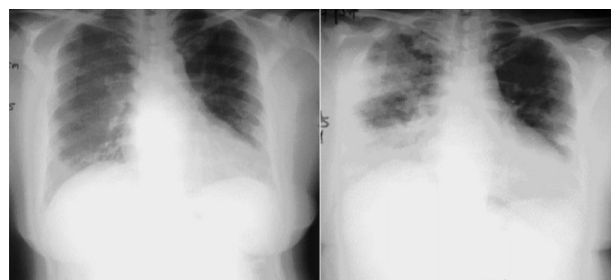

Figure 2. Chest X-ray (PA) showing evolution of a patient with predominant involvement of the right lung (Source: Avendano et al.[17])

On the other hand, a chest computed tomography (CT) scan can detect small parenchymal lesions early which are not noticeable in radiography. Common findings are: interlobular septal thickening, intralobular interstitial thickening, consolidation and ground-glass opacification, predominantly in peripheral areas and lower lobes[14]. There is a good correlation between dyspnea severity and radiological findings, and radiographic changes also increase as dyspnea worsens[17].
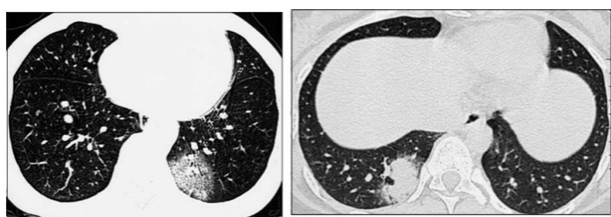
Figure 3. Axial cross-sectional chest CT with window to lung parenchyma of two patients whose chest radiographs were normal but who had ground-glass opacity (Source: Rainer et al.[16]).

SARS-Cov 2

Current evidence demonstrates that there is a great similarity in structure and pathogenicity between SARS-CoV and SARS-CoV-2; however, it is believed that the difference in the presentation of the structural spike protein (S) may be the factor responsible for the larger and faster propagation of SARS-CoV-2[15].

The main transmission mode of SARS-CoV-2 is extremely similar to that of its antecedent virus and mainly occurs via the respiratory route. Following the same analogy, patients with SARS-CoV-2 also exhibit a similar acute respiratory syndrome, although there is greater variability of clinical presentations in the new format of infection[18]. The clinical picture of COVID-19 can range from asymptomatic cases or just a cold to presentations of severe viral pneumonia. The main signs and symptoms are: fever, cough, dyspnea, rhinorrhea and myalgia[10]. Severe forms are more often seen in older adults and patients with associated comorbidities, with extensive pulmonary involvement, respiratory and multiple organ failures[1].

Radiological alterations of SARS-CoV-2

Similar to what occurs in SARS-CoV infection, chest radiology is a fundamental tool to assess patients with suspected COVID-19. However, chest radiography is not recommended as a first-line modality, as it may demonstrate normal findings in the initial infection stage[19,20]. For Chate et al.[1], radiography can be useful for monitoring hospitalized patients, as it is a fast, inexpensive and widely available method. Furthermore, according to the Brazilian College of Radiology (*CBR*), radiography also helps in cases of patients who are bedridden or unable to undergo computed tomography[2,3].

Pulmonary radiological alterations usually appear approximately 10 days after the onset of symptoms[10]. The main radiographic findings are air space opacities with bilateral distribution, predominantly in the periphery and in the lower lung fields. The extent of the disease can be quantified taking into account the dispersion degree of pulmonary opacity[2,3]. It is noteworthy that these findings may be underestimated when compared to computed tomography[22].

The resolution of imaging findings is usually observed on the 26th day of symptom onset, and should not be used as a criterion for patient discharge, nor should they be considered as a treatment control method[22].
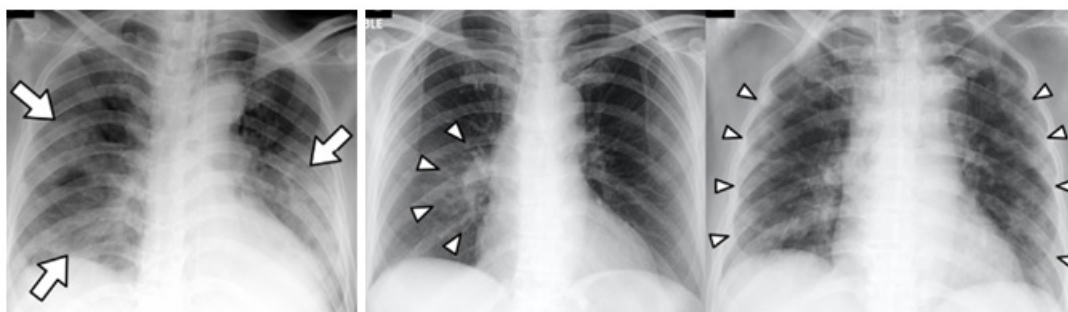

Figure 4. Chest X-ray (PA) showing (A) diffuse consolidations; (B) perihilar distribution consolidations; (C) peripheral consolidations (Source: Wong et al.[26]).
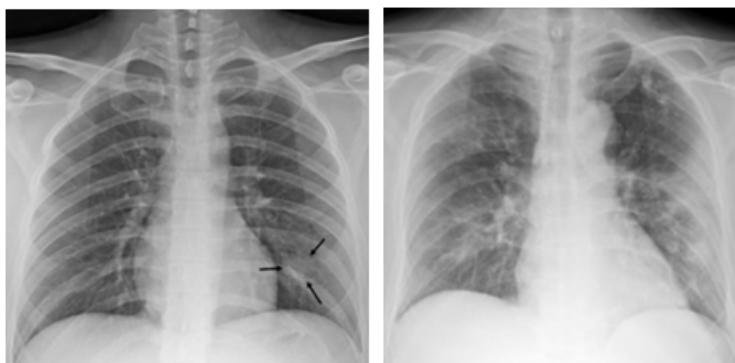

Figure 5. Chest X-ray (PA) showing (A) single nodular lesion; (B) ground-glass opacities (Source: Yoon et al.[23]).

Differently from radiography, chest CT scan can better detect pulmonary findings, having high sensitivity in SARS-CoV-2 infection. However, up to 50% of cases may present a normal chest CT in the first days after the onset of symptoms, and therefore it should not be considered when excluding the diagnosis when it comes to recent infection[19]. The *Colégio Brasileiro de Radiologia* also adds that this tool should also not be used for screening. Thus, an indication for using chest CT in COVID-19 is reserved for symptomatic patients with normal radiographs or with indeterminate findings, monitoring severe cases and evaluating complications. It is noteworthy that a normal chest CT does not exclude a diagnosis of COVID-19[2,3].
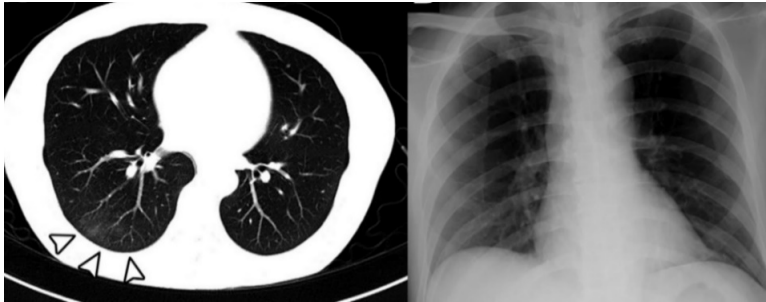

Figure 6. (A) CT in axial section – image on the left; (B) chest X-ray – image on the right. Axial cross-sectional chest CT (A) with window to lung parenchyma showing ground-glass lesions in a patient with COVID-19, but not visible in the chest radiography (B) (Source: Wong et al.[26])

Tomographic images must be obtained without contrast medium and evaluated with the pulmonary and mediastinal window settings[23]. The main pulmonary alterations in COVID-19 are: ground-glass pattern, focal consolidations (including inverted halo opacities), with bilateral and multilobar involvement, peripheral distribution and predominance in the middle, inferior and posterior lung fields. The shape of the lesions is typically poorly-defined, irregular and confluent[24,25].

Ground-glass opacity is an increased attenuation of the lung parenchyma which does not obscure the contour of the vessels and bronchi and that occurs due to partial filling of the air space. On the other hand, consolidation represents a more intense filling of the air space and consequently greater pulmonary attenuation, even obscuring the bronchial and vascular contours; in addition, an air bronchogram sign may appear, which refers to visualizing the bronchial lumens within an opacity. There may also be the presence of some diffuse ground-glass areas surrounded by consolidation rings, configuring the inverted halo sign, usually identified in later presentations. On the other hand, the "crazy-paving" pattern is characterized by inter and intralobular septa thickening superimposed on the ground-glass pattern, simulating a cobblestone sidewalk[26,27].

Figure 7. (A) CT in axial section – images on the left; (B) Coronal section CT - right image. Axial (A) and coronal (B) chest CT with window to lung parenchyma demonstrating multifocal and bilateral and peripheral ground-glass opacities (Source: Yoon et al.[23]; Araujo-Filho et al.[19]).
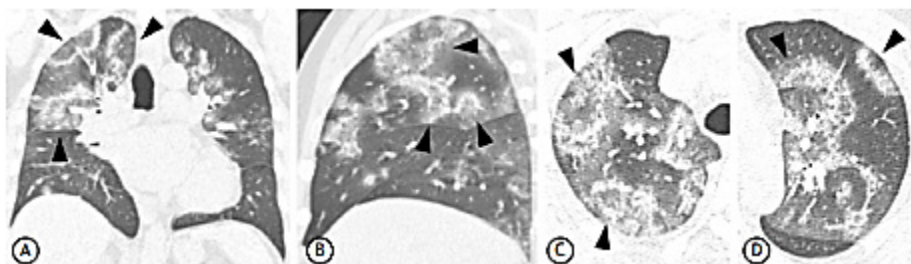

Figure 8. Chest CT with window to lung parenchyma in different views, (A) coronal; (B) sagittal (C and D) axial showing inverted halo sign (Source: Farias et al.[13]).
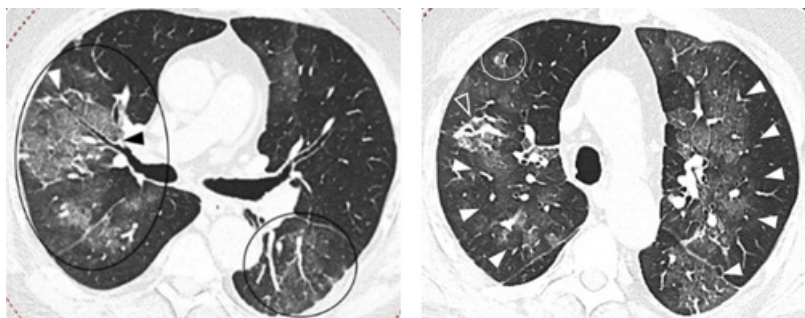
Figure 9. Axial chest CT with window to lung parenchyma showing bilateral ground-glass with overlapping interlobular septal thickening and intralobular lines forming the "crazy-paving" pattern with thickening of the bronchial wall (black arrow) and small vascular enlargements (white arrow) (Source: Carotti et al.[11])

Such findings are not exclusive to COVID-19 and can be found in other lung diseases. Therefore, the Radiological Society of North America proposed a division of tomographic findings: typical, indeterminate, atypical and negative for COVID-19[22].

Table 1 – Relation of tomographic findings with the probability of COVID-19.

| TYPICAL	INDETERMINATE	ATYPICAL	NEGATIVE
Ground-glass pattern with or without consolidation; Intralobular lines – "crazy-paving" pattern; inverted halo sign.	Diffuse, perihilar or unilateral presentation; Ground-glass pattern with or without consolidation.	Isolated lobar or segmental consolidations; Small nodules; Cavitation; Mild septal thickening with pleural effusion.	Radiological study not presenting features suggestive of pneumonia.

Source: Farias et al.[22]
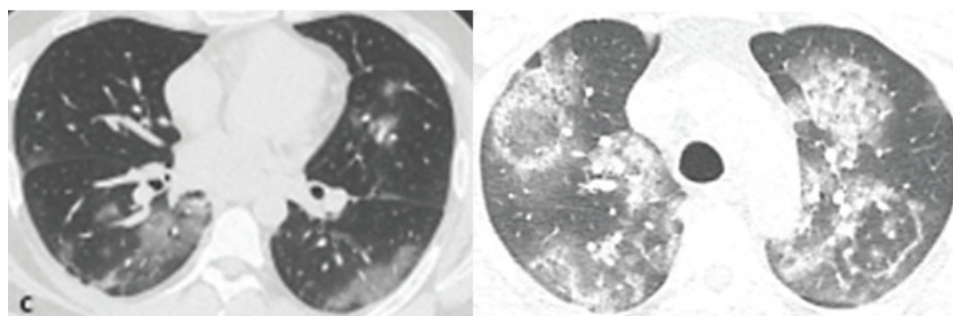
Figure 10. (A) CT in axial section – image on the left; (B) CT in axial section – image on the right. Axial cross-sectional chest CT with lung parenchyma window showing typical findings: (A) bilateral, multifocal ground-glass pattern with consolidation areas; (B) ground-glass pattern surrounded by consolidation rings (inverted halo sign) (Source: Farias et al.[22]).
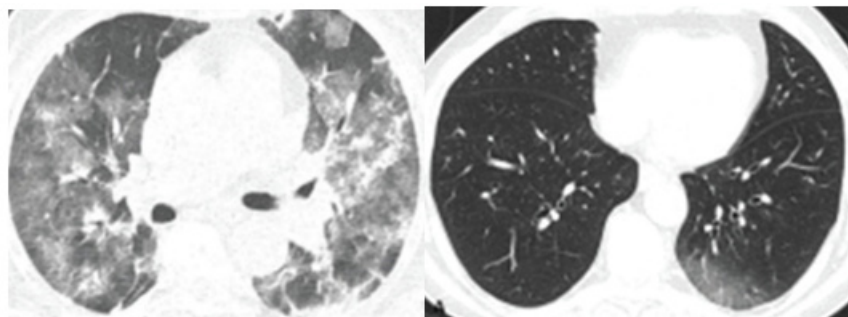

Figure 11. (A) CT in axial section – image on the left; (B) CT in axial section – image on the right. Axial cross-sectional chest CT with lung parenchyma window showing indeterminate findings: (A) diffuse ground-glass pattern; (B) one-sided ground-glass pattern (Source: Farias et al.[22]).
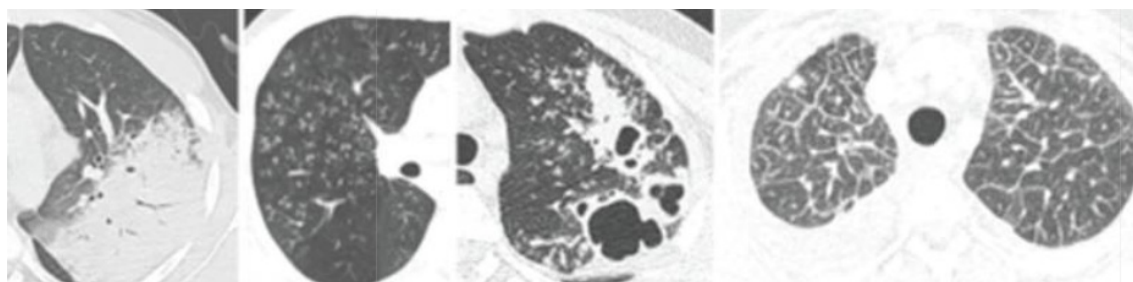
Figure 12. Axial CT of the chest with atypical findings: (A) isolated consolidation; (B) Small centrilobular nodules; (C) cavitations; (D) interlobular septal thickening with pleural effusion (Source: Farias et al.[22]).

Araujo-Filho et al.[19] adds that incipient pulmonary scarring (fibrotic streaks), septal thickening, reticular changes superimposed on alveolar changes, and pleural effusion are more frequent in advanced stages of the disease (after 8-14 days).

CT scan patterns in COVID-19 vary according to disease progression and the number of lesions can rapidly increase as the pathology progresses. Ground-glass opacities predominate on the first two days; then the appearance of pulmonary consolidations begins between the 3rd and 4th day; there is subsequently an increase in the extent of pulmonary involvement and the appearance of mosaic crazy paving and consolidations between the 5th and 8th day; then the most advanced consolidation stage is found between the 9th and 13th days (peak findings); and after the 14th day there is persistence of ground-glass opacities and regression in the other findings (Table 2). The complete resolution of tomographic findings is slow, lasting up to 30 days.[1] Therefore, the *Colégio Brasileiro de Radiologia* does not recommend performing a chest CT to analyze the recovery of pulmonary changes in patients who are already clinically stable, nor as a criterion for hospital discharge[2,3].

Table 2 – CT findings according to phases.

INITIAL PHASE (1-2 days)	INTERMEDIATE PHASE (3-6 days)	LATE PHASE (7-14 days)
Normal in 40-50% of cases; Focal ground-glass opacities.	Normal in 10-25% of cases; Predominance of consolidations.	Normal in up to 5% of cases; Predominance of consolidations; Reticular opacities; "crazy-paving" pattern".

Source: Dias et al.[12]

SARS-Cov X SARS-CoV-2 – O Diagnóstico

There are three tests for laboratory diagnosis of SARS-CoV: ELISA, IFA (immunofluorescence assay) and PCR[7,16.] The ELISA is used to detect IgG antibodies, which start to increase around the 7th to 10th day after the onset of symptoms, and IgM, which usually appear earlier[5]. Although the ELISA method is safe, it is not the test of choice for diagnosing SARS-CoV in the initial stage of the disease[5]. The IFA is also capable of detecting antibodies, but it only becomes important after the 10th day of infection[5]. Finally, PCR is used to detect viral genetic material, making it possible to diagnose the disease in its early stages[5,7]. The main limitation of the PCR method used during the first SARS outbreak in 2003 was the low sensitivity and consequently the large number of false-negative results[7]. Therefore, due to the above limitations, it is not recommended to diagnose SARS-CoV only with laboratory methods, as one must combine the clinical presentation, the contact history with patients and the compatible radiographic findings[7, 17].

On the other hand, a diagnosis of SARS-CoV-2 infection is based on the clinical history, associated with a positive result of the rRT-PCR (real-time reverse transcription polymerase chain reaction)[28]. This method is considered the gold standard for COVID-19 by the WHO, and enables identifying viral RNA in samples from nasopharyngeal aspirates, nasal and oral swabs. The test must be performed after the onset of symptoms, between the 3rd and 5th day to avoid the possibility of false-negative results[28]. Serology enables identifying IgA, IgM and IgG antibodies in the patient's blood samples, which begin to be produced from the 7th day of the disease[28].

SARS-Cov X SARS-CoV-2 – Radiological findings

SARS-CoV and SARS-CoV-2 have many similarities in terms of structure, transmission, pathogenicity and clinical presentation[15]. Therefore, pneumonia caused by COVID-19 shows radiological similarities with SARS, both presenting a predominance of a bilateral ground-glass pattern and consolidated lesions in the peripheral lung[9,18].

Despite the similarities in CT findings, COVID-19 pneumonia appears radiologically milder than SARS pneumonia. According to Yoon et al.[23], upon analyzing the proportion of patients with initial abnormal radiographic findings, it was noticed that 78.3 to 82.4% of patients with SARS had altered exams, in contrast to 33% of patients with COVID-19.

Finally, we observed similarity regarding the radiological alterations presented in both diseases. Ground-glass pattern, consolidation, and crazy paving, especially located in the lower lobe, are the main common findings.

However, when we take into account the severe conditions, the radiological evolution occurs at a more significant rate in patients with SARS-COV[23].

Table 3: SARS-Cov X SARS-Cov-2 radiological findings

SARS-CoV	SARS-CoV-2 – COVID-19
Radiography: pulmonary radiological alterations appear 3 to 7 days after the onset of symptoms, starting with a unilateral lesion, which progresses to multiple lesions or to a ground-glass appearance, with diffuse infiltrates and predominance in the lung bases. **CT**: interlobular septal thickening, intralobular interstitial thickening, consolidation and ground-glass opacification, predominantly in the peripheral areas and lower lobes.	**Radiography:** pulmonary radiological alterations appear 10 days after the onset of symptoms, such as predominantly peripheral bilateral opacities and in the lower lobes. **CT**: ground-glass opacities, focal consolidations (including inverted halo opacities), with bilateral, multilobar involvement, peripheral distribution and predominance in the middle, inferior and posterior fields.

Source: The authors, 2020.

Chest radiography is not a first-line modality regarding the method choice for analyzing pulmonary involvement at the radiological level in COVID-19, presenting normal findings in the initial stage of the infection or showing ambiguous and non-specific lesions, resulting in low diagnostic sensitivity and specificity[19,20,22,23]. However, chest radiography gains space in cases of patients who are unable to perform chest CT and for monitoring hospitalized patients, as it is a fast, cheap and widely available method[1,2].

Chest CT is the gold standard test to assess pulmonary involvement in COVID-19, including early pathological findings[20,23,24,26]. It is an excellent diagnostic tool, being effective in detecting the disease even in the absence of symptoms[11]. It is even possible to identify pathological findings in chest CT in the same time frame in patients who presented an X-ray with no changes[27]. However, it should not be used as a screening tool[3].

On the other hand, the availability of radiological study methods was different at the time of the first SARS virus epidemic between 2002 and 2003, with chest tomography being difficult to access[7]. Therefore, in this context, chest radiography was the method of choice, as it was the most available[7].

FINAL CONSIDERATIONS

The radiological alterations of SARS-CoV and SARS-CoV-2 are generally similar, although there are some differences regarding the greater virulence of the first virus and its consequent greater pulmonary involvement seen in the radiological images. As for the best imaging method, considering the fact that the pandemic threatens to overwhelm health systems around the world, radiography can be estimated as a cheaper and more accessible tool, being useful to identify the infection, even if less sensitive than computed tomography. Furthermore, the story of SARS-CoV-2 continues to evolve and is likely to have characteristics of its own that we will learn as the outbreak progresses.

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