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Diagnostic Imaging Technologies applied to the COVID-19 scenario

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1. Introduction

Pandemic of the disease caused by the new coronavirus 2019 (COVID-19) showed up the importance of the technologies used in the routine of diagnostic imaging services. Patient care, with suspected or confirmed infection, involves specialist professionals with different undergraduate degree to obtain images with diagnostic reliability and respecting biosafety guidelines. In this scenario, one of the challenges of the diagnostic imaging services professionals is in the care management of the patient according to the complexity inherent to the physical principle of operation of each image technology and assuring biosafety principles.

According to the Brazilian College of Radiology and Diagnostic Imaging (CBR) [1] the definition of the diagnosis of COVID-19 will be confirmed by clinical-epidemiological information added to RT-PCR (Polymerase Chain Reaction) and/or serology tests. Additionally, imaging diagnostic methods will be properly used as a diagnostic complement. In this context, the main modalities used for different clinical indications related to COVID-19 in Radiology are Medical General X-Ray (XR); Computed Tomography (CT); Ultrasound (US); Magnetic Resonance Imaging (MRI); and Scintigraphy in Nuclear Medicine (NM).

The aim of this work is to present all the diagnostic imaging technology available to be used in COVID-19 scenario, their applications, and contributions.

2. Methodology

A retrospective and descriptive research was carried out based on the key words: imaging diagnostic technologies and COVID-19.

3. Results and Discussion

Table 1 presents the imaging diagnostic technologies used for different clinical indications related to COVID-19 in Radiology.

Table I: Imaging Systems features used in Radiology for the COVID-19 diagnostic.

Modality		Technology	Radiation Type
i	Medical General X-Ray	X-Ray Tube Stationary	Atomic Ionizing Radiation
ii	Computed Tomography	X-Ray Tube Giratory	Atomic Ionizing Radiation
iii	Ultrasound	Transducer	Mechanical Wave
iv	Magnetic Resonance	Magnet and Radiofrequency Coils	Radiofrequency and Magnetic Field
v	Nuclear Medicine	Camera-Gamma	Nuclear Ionizing Radiation

3.1 Medical General X-Ray

This modality generates 2D anatomical images from X-Ray. Medical X-Ray are usually the fastest and cheapest means when compared to other imaging diagnostic methods, as they have easy-to-handle models, such as portable and fixed equipment. In addition, X-Ray equipment assists several patients, from prompt care to bedridden patients. It can discover bone fractures and detect pneumonia and other structural changes from different densities.

3.2 Computed Tomography

CT scans generates anatomical and morphological 3D images using X-Ray. The images are acquired in the axial plane and can be reconstructed in the other planes or 3D volume using computational tools. CT scanner uses a motorized X-Ray source that rotates around the circular opening structure called a gantry. The CT 3D images allow studying soft tissues, muscle damage and the internal body organs. addition to identifying bone fractures, pneumonias, and other structural changes of different densities as well as in the 2D images from the Medical X-Ray. Radiation exposure levels are an important consideration for deciding between CT scan and an X-Ray.

3.3 Ultrasound

Ultrasound imaging uses high-frequency mechanic waves transmitted by transducers to view inside the body. US images can also show movement of the body's internal organs as well as blood flowing through the blood vessels. There is no ionizing radiation exposure associated with this imaging technology.

3.4 Magnetic Resonance Imaging

MRI scanners use strong magnetic field, gradients, and radiofrequency waves to generate images of the anatomy and the physiological processes of the organs in the body. This modality is particularly well suited to image the soft tissues of the body. MRI does not use ionizing radiation but employs a strong magnetic field that requires specific care when entering metal materials into the examination room.

3.5 Nuclear Medicine

Nuclear medicine imaging produces images detecting gamma radiation from different parts of the body after a radioactive tracer is administered to the patient. The images are digitally reconstructed and generated on a computer. The detectors or gamma cameras generate static and/or dynamic images applied to biochemical, metabolic, and functional study of organs and tissues of body.

Different imaging procedures may be indicated for mild, moderate, and severe symptomatic patients. Therefore, imaging procedure is not indicated for asymptomatic patients according to CBR.

Gold standard procedure as a complementary diagnosis of COVID-19 is high-resolution computed tomography (TCAR) of the chest. Venous contrast medium is not indicated and should be reserved for specific situations after the radiologist's assessment. However, TCAR there is no should be used alone for the diagnosis of COVID-19, neither should it be performed for disease screening.

Other non-invasive imaging procedures such as radiographs, magnetic resonance and chest ultrasound or pulmonary scintigraphy can also be used as a complementary and alternative method in the diagnosis of COVID-19 [1-4], especially in cases of bedridden patients or without conditions to do CT scan of the chest.

4. Conclusions

Imaging diagnostic technologies are complementary methods widely used in the scenario of COVID-19 diagnostic. Therefore, it is important to know and differentiate the physical principle and the different images generated by these technological tools. This contributes to a better understanding of the handling and the treatment of the disease. In addition, those Imaging diagnostic technologies can be used, if it is of clinical interest, during the patient's recovery process.

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