

# Role of HRCT in Covid-19

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**Abstract**—High-resolution computed tomography (HRCT) is a modern form of imaging which is more accurate than the traditional chest X-rays in diagnosis and follow-up of the diseases of the lung tissues and airways. In the present-day CT technology, volume HRCT is possible and covers the whole lung. Moreover, contrast-enhanced CTs of the chest or entire body can be reconstructed into the HRCT images.

HRCT is very popular in the diagnosis of acute and chronic diffuse lung disease. Typical signs are idiopathic interstitial pneumonias, including idiopathic pulmonary fibrosis, and occupational lung diseases, including pneumoconiosis, including asbestosis. It is also useful in the diagnosis of acute diseases like infections, drug-induced pulmonary reactions and diffuses injury of the alveoli.

The medical history of the patient is critical to making accurate interpretations of findings in HRCT because imaging findings are usually non-specific. Hence, effective diagnosis and management of patients require well-planned and well-written clinical referrals.

## I. INTRODUCTION

A computed tomography (CT) scan is a non-invasive radiographical procedure, a medical imaging method of obtaining a detailed picture of the internal structure of the body which can be used in diagnostic procedures. It is undertaken by qualified radiographers. Sir Godfrey Hounsley invented the method and he was the winner of the Nobel Prize in 1979. The initial CT scan was that of the head.

- CT imaging has special features which are:
- Image generation of cross-sectional bests.
- Eradication of structural superimposition.
- Limited effects of tissues on it.

Better capability to identify finer differences in X-ray attenuation than in traditional radiography and it is due to a lowered scatter.

The High-Resolution Computed Tomography (HRCT) is a better imaging technique, which is more accurate when compared to the conventional chest X-rays in the diagnosis and follow up of the diseases related with lung tissue and airways.

It is a new coronavirus (2019-nCoV), which initially was identified in December 2019 in Wuhan, Hubei Province, China. It was initially referred to as pneumonia of unknown etiology, but turned out to be a coronavirus and was called COVID-19. On February 11, 2020, the World Health Organization (WHO) declared the virus a pandemic, and it rapidly spreads across the globe.

Chest x-ray is the most widespread imaging method of patients suspected to have COVID-19. However, chest CT is a new practice in the diagnosis of COVID-19. In a 5-patient study that was undertaken on 19 patients with normal CT, two negative outcomes occurred in reverse transcriptase-polymerase chain reaction (RT-PCR) testing.

False-negative RT-PCR might come as a result of various factors including low levels of viral RNA, improper collection of samples, and bad extraction of nucleic acid. Such restrictions can lead to a negative test outcome even in case of clinical disease.

The report examines the CT findings of the chest of five patients with COVID-19 pneumonia that had two consecutive negative RT-PCR. It is also addressing their clinical presentation and characteristic features of imaging.

## II. BASIC PRINCIPLE

Computed tomography is based on the idea that an internal structure of an object can be built or recreated by making use of multiple projection images. CT scanning is primarily aimed at gathering as much data as possible as a high volume of information on a thin, two-dimensional slice of transverse data, and then applying that data to rebuild the internal structure of the slice.

The Ray projections come about after a thin slice of the body has been scanned by a narrow beam of X-rays and the radar of the radiation, which passes through, is measured by very sensitive detectors. These detectors are not direct image formers but rather they measure and record the overall energy of transmitted photons. A computer is then used to process the numerical data provided by several projections in such a way that they create a detailed image.

A CT image consists of each pixel as a small volume in the slice of the body that it is representing, a voxel. Thus, a two-dimensional CT scan is a one-dimensional slice of the patient as the three-dimensional data is condensed into a two-dimensional form.

## III. EQUIPMENT

The fundamental idea of computed tomography (CT) is that the internal structure of an object can be formed with the help of the multiple projections made at various angles. The patient is positioned on a table in the scanning where he rotates around the CT gantry that resembles a ring in shape that is large. An X-ray tube spins around the patient and produces a very thin beam which travels through the body and is detected by a circular array of detectors.

The X-ray beam intensity reaching the detectors is also determined by the absorption nature of the tissues that it passes. The X-ray source spins around exposing every tissue in a variety of positions. The data obtained are run through mathematical programs, e.g. Fourier analysis, to re-form the density and location of internal structures in each slice.

A slice of a tomography is a thin slice of the body which is created by a set of projections made at different angles around the body. The CT images

have better distinction of soft tissues with other body structures.

Such projections are created by passing the beams of X-rays in the body at various angles and recording the radiation that is transmitted. The computer is able to rebuild images of the internal anatomy in detail by a combination of several projections and their analysis.

## IV. CT NUMBER

“The Hounsfield Unit (HU) scale is a linear standardization of linear attenuation coefficients that are obtained in a computed tomography. The value of radiodensity of distilled water at standard temperature and pressure (STP) are 0 Hounsfield Units (HU) and the value of radiodensity of air at STP is -1000 HU respectively on this scale.”

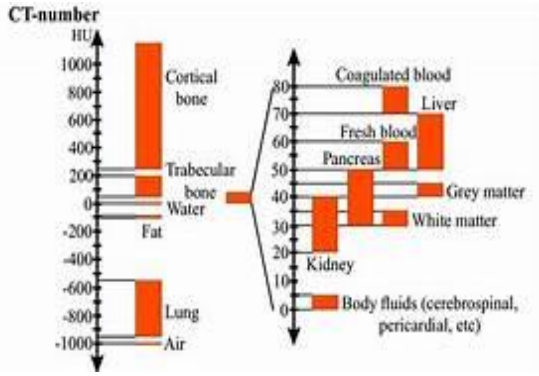
Given that the average linear attenuation coefficient ( $\mu$ ) of a voxel is ( $\mu$ ), the Hounsfield Unit value is determined using the following relationship:

$$HU = 1000 \times \frac{\mu - \mu_{\text{water}}}{\mu_{\text{water}} - \mu_{\text{air}}}$$

A change of a Hounsfield Unit (HU) is nearly equal to a 0.1 percent change in the attenuation coefficient of water due to the fact that attenuation coefficient of air is nearly zero. This scale is developed with the foundation of CT scanners that have water as a reference and one that is used to represent the radiodensity of various body tissues and materials.

HU scale may be applied in medical grade dual-energy CT scanning but not in cone beam computed tomography (CBCT). These values are not exact and may vary depending on studies.

The measurements in Hounsfield Unit can be different according to the difference in the parameters of acquisition and reconstruction, which include tube voltage (kV), filters, and reconstruction algorithms. Besides, introduction of contrast mediums may also change the HU value of some tissues, especially in blood vessels.



V. INDICATION OF HRCT CHEST

High-resolution computed tomography (HRCT) has been found useful especially in the assessment of diffuse lung diseases that involve the pulmonary interstitium, including:

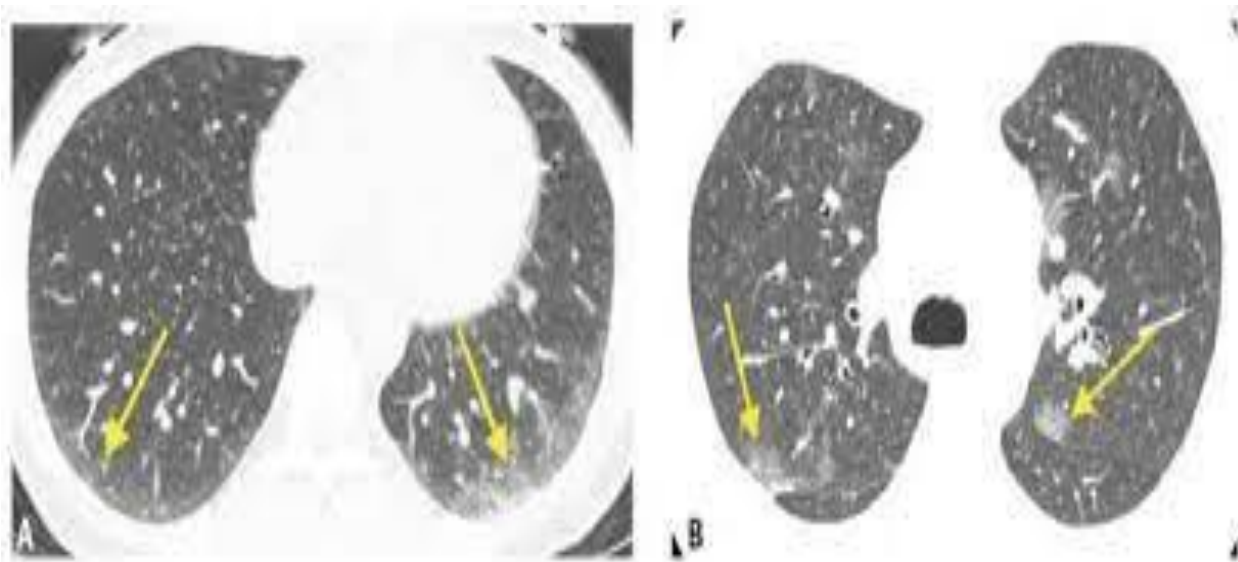
- Interstitial lung disease
- Cystic lung disease
- Small airway disease
- Pulmonary micronodules
- Bronchiectasis

HRCT is an exam that is predominantly utilized to determine the severity of the illness, track the outcome of treatment therapy as well as aid in the choice of suitable areas of biopsy in individuals with the diffuse interstitial lung diseases.

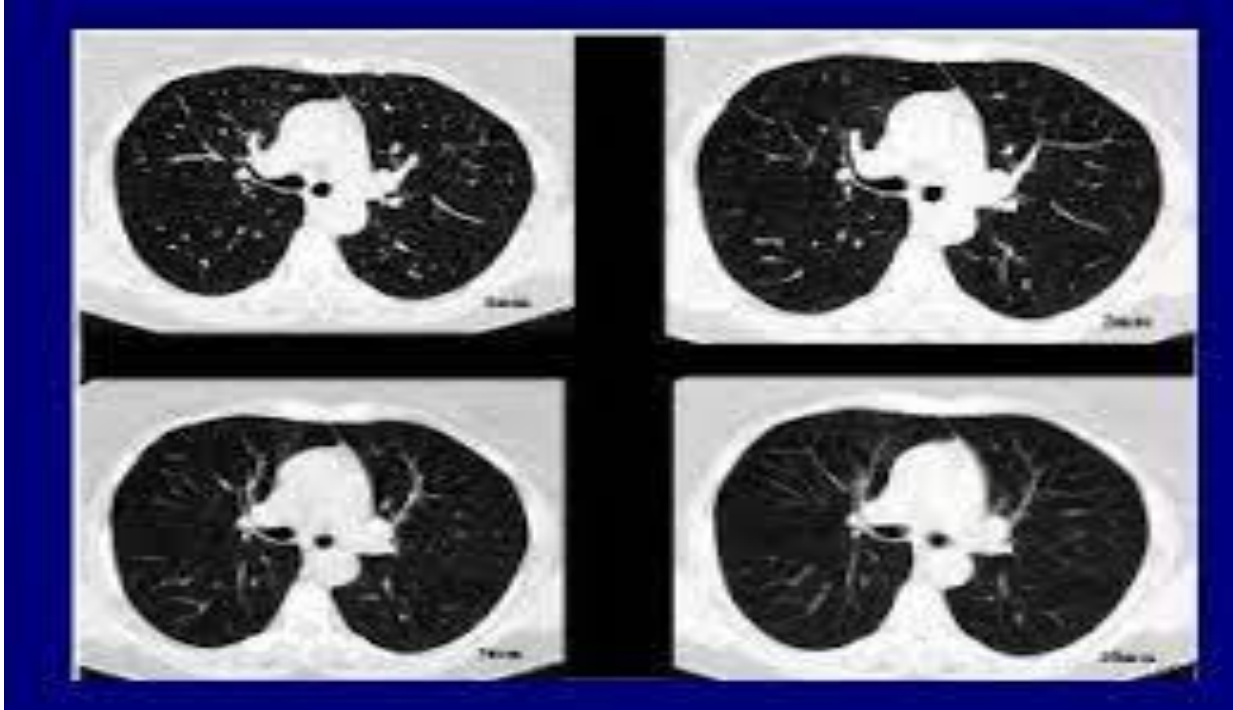
Nonetheless, the general assumption is that HRCT is just a better quality of standard CT scan of the chest. The fact is that in reality, HRCT is a specific imaging method, which is oriented at certain diagnostic purposes and its implementation is not based on any general preference but certain clinical indications.

PURPOSE

High-resolution computed tomography (HRCT) is a procedure that is used to see fine details of the lungs and also identify disease related changes that are usually difficult to see on the standard chest images. The scanning of prone-position HRCT is especially beneficial in patients suffering basal lung disease because it eliminates changes caused by gravity and dependent atelectasis, which makes the scanning more precise.



(FIG.5.1 - INDICATION OF HRCT IMAGES )



(FIG.5.2 - NORMAL LUNG ANATOMY)

## VI. TECHNIQUES

### Sequential spaced acquisition

The original research on the development of high-resolution computed tomography (HRCT) was undertaken in an attempt to increase the level of spatial resolution in the period of first-generation scanners, where image acquisition methods were sequential. It was later modified to work with second-generation helical scanners with similar imaging parameters. The technique is still used even today in some facilities using multidetector row CT (MDCT) in order to assist in reducing patient radiation dose. In extensive HRCT protocols, follow up scans are recommended sequentially with spacing with additional expiratory and prone scans, and a volumetric inspiratory acquisition. The technique provides a more detailed examination of the pulmonary pathology.

The HRCT aspects of technical importance are:

- individual slices of images which were less than 1.5 mm in dimension (equipment used in the past has slices up to 3.0 mm wide because of the equipment available then).

- 1-2 cm intervals between set of images.
- Reduced radiation dose as opposed to full-volume imaging.

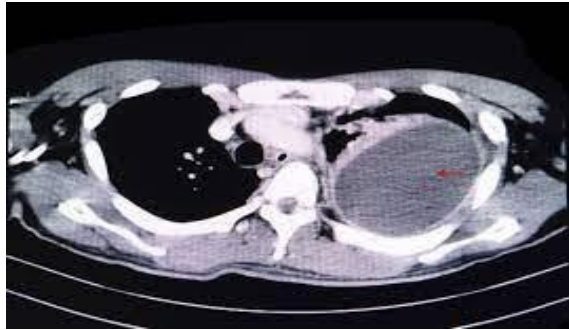
The method enables a critical examination of the lung structures in which radiation is reduced.

### Volumetric acquisition

Volumetric thin-section imaging is a common practice and multidetector computed tomography (MDCT) is so common. The thin slice volume imaging is improved in visualizing small pathological changes and also in re-constructing the image in multiple planes. Among the significant technicalities, there are:

- Less than 1.5 mm and normally about 1 mm with a range of 0.625 to 1.25 mm.
- Post-processing with high-spatial-frequency algorithm or sharpening algorithm (bone algorithm), which:
  - Reduce image smoothing
  - More spatial resolution, which makes the structures sharper and more detailed.
  - Enhance the appearance of streak artefacts.
- The radiation dose would be higher than with sequential HRCT methods.

The method offers visualization of the anatomical features in greater detail but it is necessary to pay attention to the radiation amount.



(Fig.6.1 - TECHNIQUES OF HRCT CHEST)

#### Reducing radiation dose

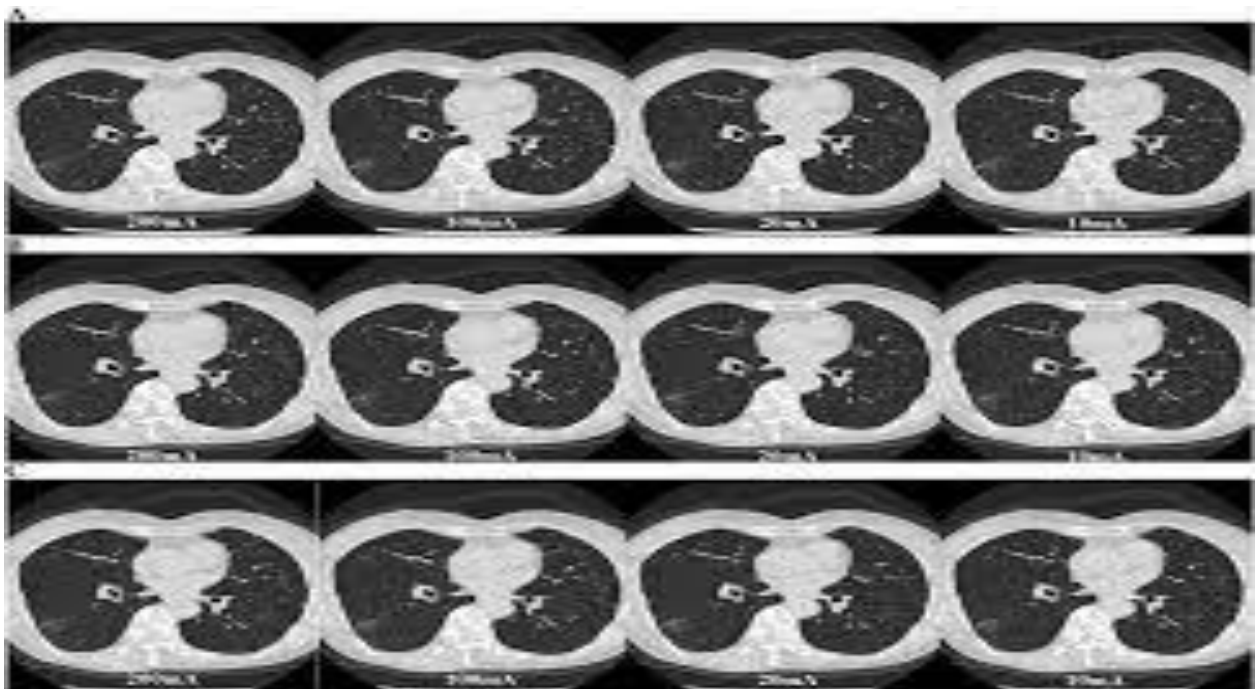
In known cases, low-dose CT protocols are quite frequently employed in follow-up examinations, and in younger patients, at the cost of slightly reduced

image quality. As a lot of patients need more than one scan to monitor their disease, such protocols assist in substantial reductions in cumulative radiation.

Individual techniques of reducing radiation dose include:

- Minimization of tube current (around 40 mAs)
- With sequentially spaced image acquisition, which is:
  - Usually used in case of further expiratory and prone scans.
  - Some institutions also used it to perform full inspiratory scans during follow-up scans.

These techniques will enable proper surveillance of the disease as well as reducing the radiation risks.



(Fig. 6.2 - REDUCTION DOSE TECHNIQUE)

#### VII. PROTOCOLS OF HRCT CHEST

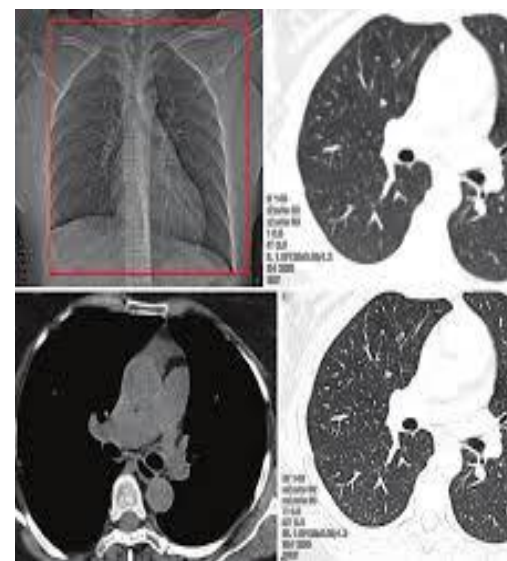
The standard technical parameters of HRCT scanner are:

- Slice thickness: 0.625 to 1.25 mm
- Scan time: 0.5 to 1 second
- Tube voltage (kV): 120
- Tube current (mAs): 100 to 200
- Collimation: 1.5 to 3 mm
- Matrix size: 768 768 or largest possible.
- Field of view (FOV): Approximately 35cm.
- Reconstruction algorithm: Large frequency of space.
- Window setting: Lung window

- Pose of the patient: Supine (usual) or prone (in the presence of interstitial lung disease).
- Level of inspiration: Full inspiration is recommended regularly; expiratory HRCT scanning is done on patients with obstructive lung diseases.

These parameters guarantee the best image quality in lung examination.

Collimation	64X0.625		
FOV	--- 350--- ---mm	Matrix	768x768
Contrast	No		
Contrast Plan	-		
Recon (IRS)	Recon into 0.6/0.33		
Reconstruction	Axial, Coronal & Sag		
PACS	Axial, Coronal & Sag		
Filming	Only if asked & only for patients referred from outside hospital		



(Fig. 7.1 - IMAGING PROTOCOLS FOR HRCT CHEST)

### VIII. PROCEDURE

- Why HRCT Chest is done?

Computerized tomography (CT) of the chest at high-resolution (HRCT) is an investigation that is preferred to diagnose lung abnormalities and unexplainable chest conditions. It is commonly applied in measuring different respiratory disorders and tracking the progression of an illness.

The typical clinical uses of HRCT are:

- Evaluating lung performance and threat of acquiring diffuse lung ailments.
- Identification of airflow blockage in the lungs.
- Detecting malignant tumor enlargement.
- DSA: Helping to choose the most suitable location of biopsy in case it is necessary.
- Lung infection diagnosis: pneumonia, bronchitis, tuberculosis, and cystic fibrosis.
- Assessment of the abnormalities identified in chest X-rays and the traditional CT scan.
- Identifying the severity and the course of infections.

HRCT has been brought to the forefront of the respiratory diagnostics through these applications.

- How to prepare for an HRCT chest scan?

Protocol	HRCT Helical		
Patient Position	Supine- Feet First		
Scano	AP-180 <sup>0</sup>		
Area Coverage	Apex of lung – Chostopherenic angle		
Scan Direction	Cranio caudal		
Gantry Angle	0		
Routine Plan			
Start Location	Apex of lungs		
End Location	Base of lungs		
Slice thickness	1 mm		
Increment	10 mm		
kV, mAs/slice	---120-----, --369-----		
Resolution	-HIGH-	Filter	-LUNG

HRCT scan is a non-invasive imaging test which does not require any special preparation. No contrast material is usually given and the patient can resume his normal activities and food. Nevertheless, there are some cases when a patient can be requested to starve several hours before the examination.

Patients are requested to carry all their medical records and prescriptions to help radiologists to compare clinical results with imaging results in order to diagnose them instantly. Patients come into the scanning room where they are given a loose and comfortable garment and asked to take off all jewelry and other metallic objects and make sure, they do not interfere with quality of the images.



(Fig. 8.1 - PROCEDURE OF CT DURING SCAN)

▪ HRCT Chest Procedure

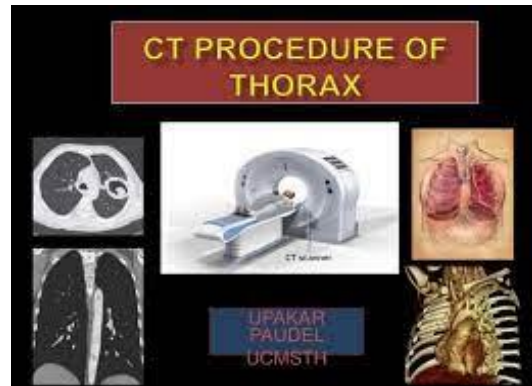
The Hrcr scan is carried out using trained technicians. Through the process, the patient is lying on a movable table which moves into a large and circular CT scanner that is in the shape of a donut. The patient is normally placed in supine position where the patient is lying on the back with both hands up over the head.

To avoid blurry images patients are advised to not move, and to hold their breath so as to have clear and correct imaging. The HRCT chest scan normally takes five minutes after being placed in the scanner.

After the scan

- Patients can go back to normal eating and normal activities the very next day of scan.
- Printed pictures can typically be delivered in the space of two hours after examination and written report can be delivered in 24 to 48 hours.

Caution: Pregnant women are to tell their physician prior to taking the scan because CT entails the use of ionizing radiation that could be harmful to the fetus



(Fig. 8.2 - PROCEDURE OF HRCT CHEST)

IX. ROLES OF HRCT CHEST IN COVID -19

Typical observations of the clinical suspect cases of novel coronavirus (COVID-19) pneumonia characteristically findings on the chest computed tomography (CT) scans may be observed even in cases where the test subjects are known to be found negative on real-time polymerase chain reaction (RT-PCR) assays. The study was supposed to describe the CT appearance of the five patients with radiological suspicion of the COVID-19 pneumonia with good negative results in initial and subsequent RT-PCR.

The five of 19 patients in our facility that were confirmed with clinical and/or radiological diagnosis and positive CT results were considered eligible to take part in this research in the presence of typical CT implications and two negative RT-PCR findings. Two radiologists of a local general hospital were randomly requested to review the chest CTs without any idea about the RT-PCR results. The scans were evaluated as per the pattern, densities and distribution of pulmonary opacities.

Results

“Among the 19 patients under the analysis, five (26%), patients did not possess any positive RT-PCR results, but negative ones, but displayed positive CT images of COVID-19 in the chest area. All the CT images of the five patients were normal. The patient had single isolated GGOs as well as four patients with isolated GGOs and consolidation. The bilateral, posterior and peripheral distribution of the lung involvement was the common one.

These five patients had a CT severity of between 5 and 14. The average of three patients was a median score of 5 that categorizes mild disease. A patient

with a score of 8 was considered to have a moderate disease and a patient with a score of 14 was considered to have the severe disease.

Imaging of the patients was done on non-contrast high-resolution CT (HRCT), arterial phase CT in the chest or CT pulmonary angiography (CTPA). The scans were all performed in GE Frontier CT scanner (GE Healthcare, Chicago, IL), on a supine position of the patients.

The following were the technical parameters of the examinations:

- HRCT and CT chest-abdomen-pelvis (CAP): 120 V, auto-modulated mA, 0.625mm slice thickness, 512x512 matrices.
- CTPA: 100 kV, auto-modulated mA, slice thickness of 0.625 mm, 512x512 matrices.

The analysis of the images entailed classification of the lesion shape as amorphous, nodular lesions or wedge-shaped lesion and lesion margins as either well and ill-defined. In addition to this, the occurrence or the lack of 18 different imaging characteristics were recorded that had bronchial wall thickening, subpleural bands, vascular engorgement, halo sign, reverse halo sign, tree-in-bud pattern, linear opacities, septal thickening, crazy paving pattern, cavitation, cysts, pleural effusion, pleural thickening, pneumothorax, emphysema, mediastinal lymphadenopathy, subpleural sparing, and air bronchograms.

**Symptoms**

COVID-19 has different impacts on people. Majority of infected individuals record mild to moderate diseases and they recover without any hospitalization.

**Common Symptoms:**

- Fever
- Cough
- Fatigue
- Loss of taste or smell

**Less Common Symptoms:**

- Sore throat
- Headache
- Body aches and pains
- Diarrhea
- Discoloration of fingers or toes or skin rashes.

- Red or irritated eyes

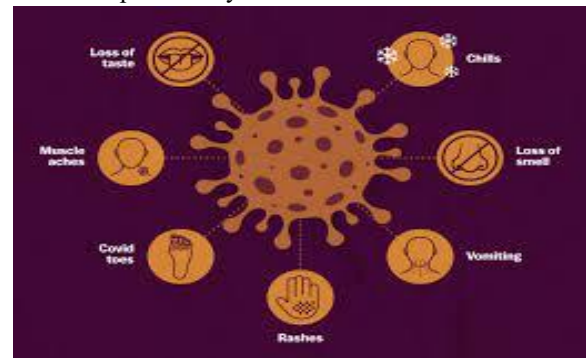
**Severe Symptoms:**

- Breathing difficulty or dyspnea.
- Chest pain
- Difficulty in speaking and moving around.

Those who have acute symptoms must take immediate healthcare and call a doctor before going to a medical center.

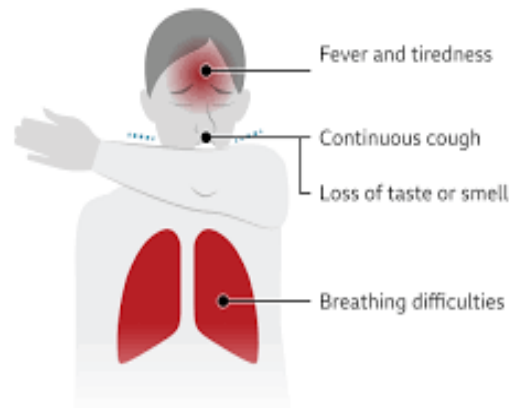
Individuals who have mild symptoms and have no preexisting health issues should avoid treatment and opt to treat their conditions at home with medical recommendations.

The symptoms normally set in between 5 to 6 days of exposure to the virus though the incubation period can take up to 14 days.



(COVID – 19 SYMPTOMS)

**Coronavirus: Key symptoms**



Source: NHS



(COMMON SYMPTOMS OF COVID 19)

**How Does Coronavirus Attack Your Body?**

Virus infects the human body by penetrating the normal cells where it multiplies and propagates. The

coronavirus attaches the spike proteins on the surface of the healthy cells, especially the lungs.

Precisely, the virus infects cells through an attachment to angiotensin-converting enzyme 2 (ACE2) receptors. Once in it infiltrates the machinery of the host cell to replicate itself, ultimately harming and destroying a portion of normal cells. Still, new data indicate that Omicron can impact the lung tissue in a smaller degree than the previous variants.

#### How Does Coronavirus Move Through Your Body?

The coronavirus virus can transmit the disease characterized as the COVID-19 that is mainly spread through respiratory droplets emitted when an infected person sneezes, coughs, breathes, or sneezes. These droplets can either be suspended in the air or placed on surfaces. The possibility of infection exists with the person being in contact with a contaminated surface and subsequently touching his eyes, nose, or mouth, through which the virus may be introduced into the mucous membranes of the respiratory system.

The immune system can respond to the newcomer during 2 to 14 days resulting in the appearance of some symptoms including:

- Fever
- Cough
- Pain in the chest or the chest struggling with a breath.
- Fatigue
- Shivers, occasionally with tremors.
- Body aches
- Headache
- Sore throat
- Watery nose or runny nose.
- Loss of taste
- Loss of smell
- Nausea or vomiting
- Diarrhea

Once the virus enters the body it goes along the respiratory system which is divided into nose, mouth, throat and lungs. The receptors of ACE2 are more concentrated in the lower respiratory tract, which is more predisposed to cause infections. Subsequently, this makes the lungs prone to the COVID-19 as compared to the common cold viruses.

It can result in inflammation of the lung tissue due to infection with breathing difficulties and possible pneumonia. This disorder is associated with the fact that alveoli, the small air sacs that carry out the exchange of oxygen and carbon dioxide, are infected. A CT scan of the chest of the affected patients will usually show patchy shadows referred to as ground-glass opacities that signify involvement in the lungs. In the majority of the patients, the symptoms are mild and should go away with fever and cough. More than 80 percent of them are mild. There are however patients who develop the disease into a more elaborate stage. Shortness of breath (dyspnea) can occur some 5 to 8 days following the onset of symptoms, and acute respiratory distress syndrome (ARDS) ensues in some severe cases

#### ▪ COVID-19 or COPD?

Even though fever can be a symptom of the COVID-19 infection, without appropriate medical examination, it is impossible to diagnose the direct cause of the symptoms, since it can be caused by chronic obstructive pulmonary disease (COPD), or any other respiratory disease. Patients with already existing COPD need to discuss the following changes with their healthcare provider:

- Deteriorating dyspnea.
- Coughing more frequently.
- New form of cough development.
- Alterations in the sputum color or quantity.
- Increased wheezing
- Low oxygen levels of the blood at rest.
- Media dependence on supplemental oxygen.
- Greater utilization of rescue inhalers.

Complications can be avoided through an early medical consultation so as to get proper treatment.

#### ▪ How to Protect Yourself

Experience vaccination against COVID-19 is a useful measure to fight against severe illness. In case the infection rates are high in your area, it is recommended that you keep the house at home as much as possible unless you need to see a doctor because of some real emergency. People with COPD, who adhere to an action plan which involves administration of antibiotics or steroids when experiencing the symptoms should check with their healthcare professional to see whether the plan has to

be changed or not, particularly in locations where SARS-CoV-2 is highly spread.

Besides overall preventive practices like handwashing regularly and keeping physical distance, COPD patients are advised to:

- Have sufficient food, household need items and medications such as 90 days or early prescription refills where feasible.
- Ensure that oxygen suppliers have sound schedules of delivering at the right time.
- Make sure that there is a working pulse oximeter and thermometer.
- Strict compliance with their COPD treatment plan.
- Adopt healthy lifestyle habits such as sleeping, exercise and proper nutrition.

The following precautions can assist in minimizing the risk of complications and aid in general health in the pandemic.

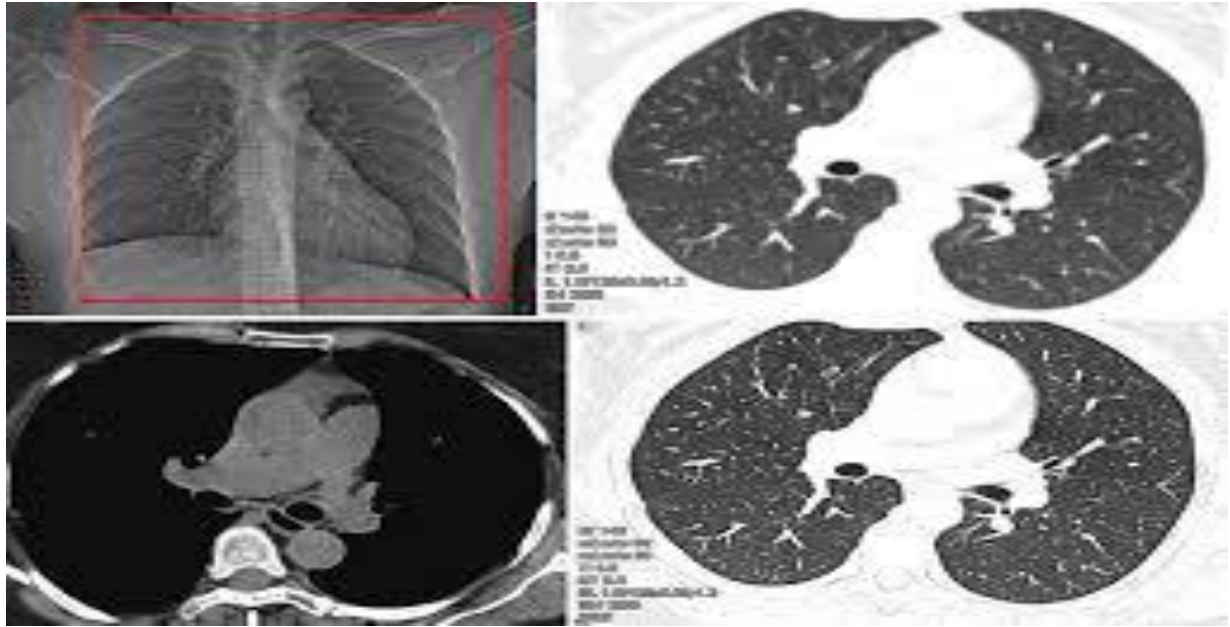
#### CT features and disease scoring

“It is important to note that chest high-resolution computer tomography (HRCT) was a useful tool during the COVID-19 pandemic because it helps understand the overall trends of the diseases and define to what extent the lungs were involved. Ground-glass opacity (GGO) was the most frequent pattern that had been observed in 125 patients (96.2%). Parenchymal consolidations followed and crazy-paving pattern followed in 75 patients (57.7) and 68 patients (52.3), respectively. Other CT

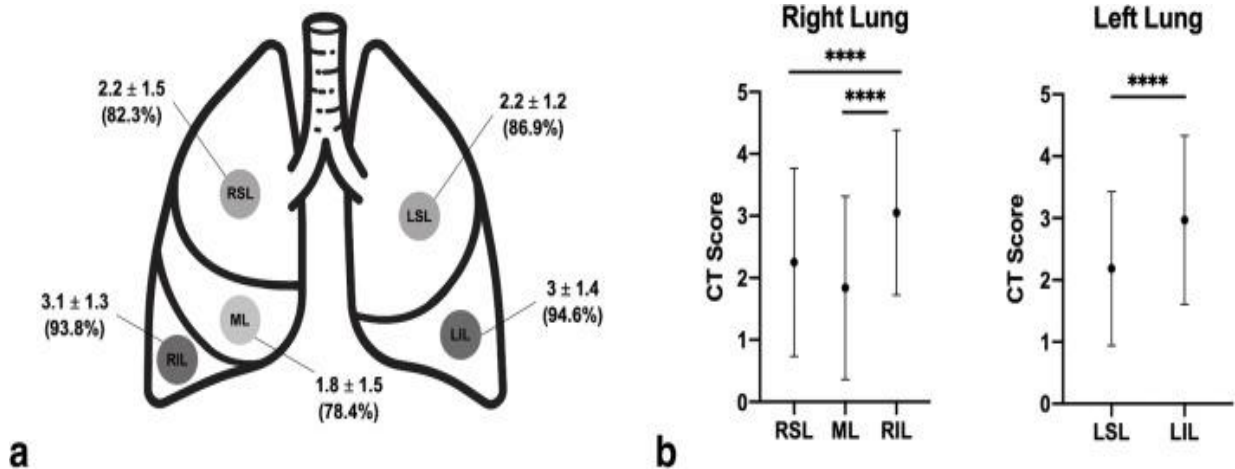
findings included fibrosis (53 patients, 40.8%), sub pleural lines (28 patients, 21.5%), reversed halo sign (5 patients, 3.8%), pleural effusion (6 patients, 13%), and lymphadenopathy (20 patients, 6.2).

The lobar involvement and the lesion distribution were also evaluated in which the pathological alterations were noticeable the most in the lower lobes. The affected right lower lobe (RLL) had 122 patients and left lower (LLL) had 123 patients (93.8 and 94.6 respectively). The mean scores of CT severity were established as  $2.2 + 1.5$  of the right upper lobe (RUL),  $1.8 + 1.5$  of the middle lobes (ML),  $3.1 + 1.3$  of the RLL,  $2.2 + 1.2$  of the left upper lobe (LUL) and  $3.0 + 1.4$  of the left lower lobe (LLL). The world average of the CT was 12.3 and the standard deviation was 11.1. A patient who had no parenchymal involvement was the only one and was rated zero.

The comparison of inter-lobe revealed that the mean CT score in the right lung RLL was significantly higher than the mean CT score in either the ML or RUL ( $p = 0.0001$ ) and no significant difference was found between the CP scores in either the RUL or the ML ( $p = 0.692$ ). It was also found in the left lung with the LLF having a significantly greater mean CT score than the LUC ( $p < 0.0001$ ). These findings indicate the relevance of HRCT chest scanning in determining the patterns of the disease as well as the severity and can help in making clinical decisions during the COVID-19 pandemic.



Comparison of the imaging of the chest that includes X-ray and CT images of the lungs, including pulmonary structures, airways branching and cross-sectional anatomy as a way of diagnostic assessment.



Lung lobe image with numeric lesion measurements RSL 2.2+1.5 (82.3%), ML 3.1+1.3 (93.8%), LSL 2.2+1.2 (86.9%), LIL 3+1.4 (94.6%).

Correlations between CT score and laboratory findings  
 The analysis of the CT scores and clinical categories showed that there is a statistically significant difference in the results when all the groups are considered as one ( $p < 0.0001$ ). Additional comparisons revealed that the critical category recorded a significant higher mean value of CT ( $20.3 \pm 3$ ; 1524) as compared to the mild category ( $8.7 \pm 4$ ; 019) ( $p < 0.0001$ ). On the same note, those who were categorized as severe patients showed much better scores on the CT ( $17.4 \pm 3.1$ ; range 1124) than those who were categorized as mild ( $p < 0.0001$ ).

Nevertheless, the severe and critical groups did not find any statistically significant difference ( $p = 0.7921$ ).

Kaplan-Meier survival curves and univariate and multivariate analyses

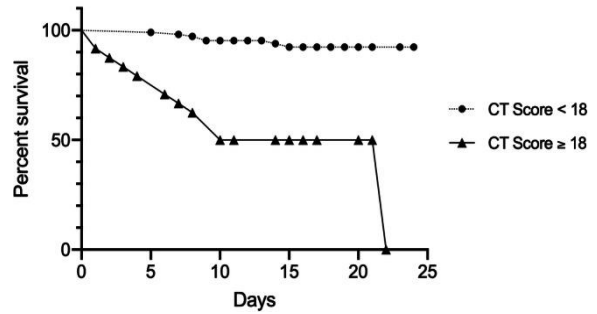
Of the 130 patients that were enrolled into the study, 20 (15.4) of them died within an average of 14.2 plus or minus 4.4 days (1-24 days). Among these 16 patients had a previously known comorbidity or more than one. Hypertension was the most common reported (occurred in 8 of the 20 deaths, 40 percent)

and 4 patients (20 percent) had no significant underlying health conditions.

The all-cause mortality among the patients aged 75 years and over (12/36; 33.3) was significantly higher than among the patients who were below 75 years (8/94; 8.5) with significance value of 0.0083. The mortality ratio was also higher in patients who were categorized as critical patients (9/9; 100%), compared with patients who had mild disease (3/79; 3.8%), and severe disease (8/42; 19%), respectively, and had a p-value of less than 0.0001 and 0.0091 respectively. Also, the mortality rate in severes was by far higher than in mild ones ( $p = 0.0204$ ).

Kaplan-Meier survival analysis also showed that the risk of death was significantly high as the CT score value was high. When an estimated cut-off of  $\geq 18$  was used, the patients demonstrated a significantly increased risk of mortality during the 24-day follow-up (log-rank  $p < 0.0001$ ; hazard ratio [HR] 0.098;  $p = 0.0201$ ).

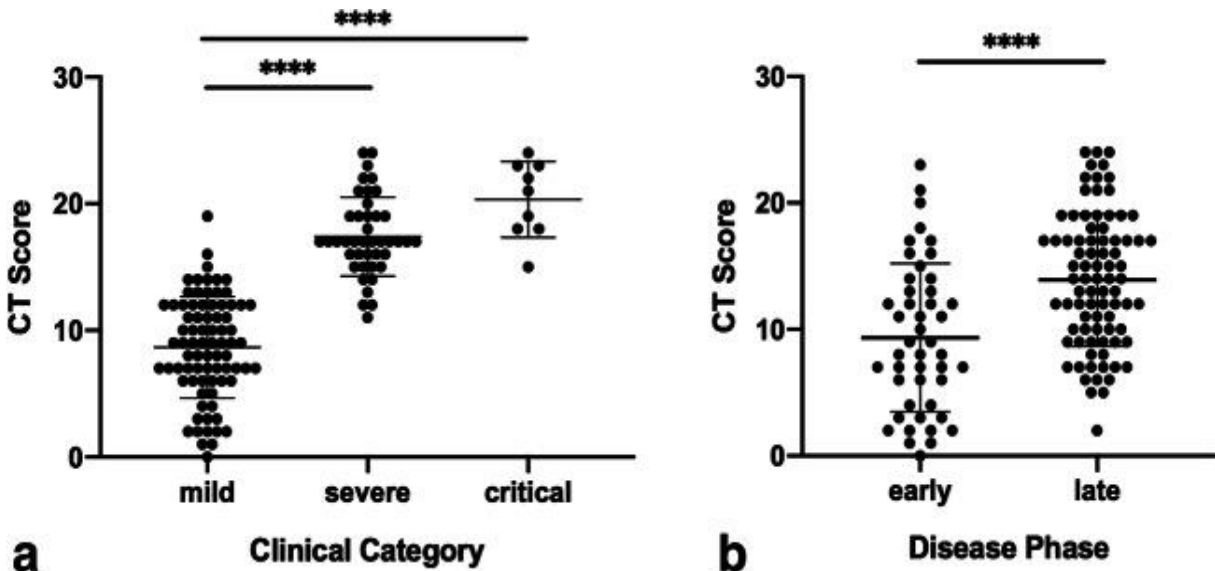
**Kaplan-Meier curve**



Kaplan-Meier survival curve: CT score below 18 demonstrates that there is approximately 95 percent survival rate at day 20, which reduces to approximately 50 percent at day 10, 0 percent at day 22.

**Conclusions**

- CT scoring can be helpful in risk stratification and can predict a short-term outcome of patients with COVID-19 pneumonia.
- The extent of pulmonary involvement witnessed on CT is closely correlated to several disease indicators such as clinical stage and laboratory outcomes.
- In general, the paper demonstrates the importance of CT in the examination of COVID-19 pneumonia, as it can be used as a rapid and efficient screening test to aid in the elimination of patients with low likelihood of the disease.



The CT scores are displayed on scatter plots, mild 0-15, severe 10-22, critical 15-25; early stage 0-20, late stage 5-25, and significant differences.

#### X. CT SCORE AND CT VALUE –CT VALUE

The third wave of the COVID-19 has already reached the world, and its infection rates are also growing. Although most people visit testing centres to confirm their results, others use at home tests. In all testing approaches, the presence of infection is identified by the cycle threshold (Ct) value.

All the COVID-19 test results contain a Ct value, and the cut-off that is set assists in defining a person as COVID-positive or negative. In the past, the Maharashtra state government petitioned the central government to clarify the correct cut-off of Ct with special reference being made to whether asymptomatic patients who had a Ct of above 24 could be termed as COVID-negative. This was a request based on a difference in recommendations made by organizations like the ICMR, NITI Aayog and NCDC.

As a reaction, the central government unified the cut-off by national consultation of virology labs, which established the Ct value of 35 to diagnose COVID-19. A Ct of less than 35 is considered positive meaning that the person should commence treatment and ensure that he/she isolates himself/herself immediately to minimize further infection. On the other hand, a Ct value of more than 35 is usually a negative outcome but even then, precautionary self-isolation can be considered in the case of close contact with infected people.

Internationally, Ct thresholds are generally between 35 to 40 in finding COVID-19 infection.

So how does Ct value decide if you have the infection or not?

Ct value is the cycle threshold that is applied in RT-PCR testing. It shows to which level the virus can be detected in a sample and can identify an individual to be COVID-positive or negative.

In RT-PCR, viral RNA is initially extracted out of the sample and then it is transformed to DNA and later on the viral presence is determined by carrying out several cycles of the process. The fewer cycles taken to detect the virus would indicate a larger viral load in the body. However, when the virus is detected

after numerous cycles, then it will be a low viral load as more amplification is necessary to detect the virus. Thus, there is an inverse relationship between the Ct value and viral load: the greater the Ct value, the less the amount of virus present, and the less the CT value, the more the viral load.

Does Ct value determine the severity of the infection? However, many researchers believe that Ct value can be used as a possible severity parameter.

- Ct value in India: -

In a 2020 advisory, the government observed that other researchers and clinicians are assuming direct correlation between high viral load and increased infectiousness or disease severity. It however pointed out that the existing evidence is not adequate in order to prove this opinion beyond reasonable doubt. The advisory also indicated some of the limitations of the RT-PCR Ct values which should be applied in order to make clinical decisions.

The government has also indicated that besides viral load, the severity of COVID-19 is also determined by host-related factors. Because of this, even those who have a comparatively low level of viral load can become seriously ill because of the increased immune reactions.

Furthermore, the warning indicated that a positive Ct value may give an illusion of being safe. Thus, it emphasized the fact of the relevance of following the preventive measures of COVID-19 despite the Ct value.

#### XI. RESULT

- HRCT chest radiography makes it possible to thoroughly examine lung infection.
- It helps in the detection of structural abnormalities in the lungs.
- HRCT is usually prescribed to patients with shortness of breath (SOB) or other disorders, including chronic obstructive pulmonary disease (COPD).
- The procedure is useful in the identification of a broad spectrum of infections and lung deficiencies.

## XII. CONCLUSION

- This test proves to be more sensitive as compared to standard chest radiography in the identification of lung lesions, especially in primary healthcare.
- The pattern observed is usually characterized by an intermittent, patchy opacities of different degrees of attenuation in several segments of the lungs.
- Patterns of HRCT that are related to lower respiratory tract infections (LRTIs) ought to be addressed as significant differential diagnosis in the assessment of patients with symptoms of lower respiratory tract disease.

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