Early Diagnosis COVID_19 by Computed Tomography Scan

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Abstract: COVID_19 is a virus that infects the respiratory system and causes pneumonia, kidney failure, and other health issues. The purpose of early diagnosis of COVID_19 is the fastest time to keep healthy cells for patients. A check-up for COVID_19 has been performed for patients whose ages were between (85−25) years by CT scan and laboratory-analysis (PCR) and X-ray and PET/CT scan. CT scan is considered the more clear method for the early diagnosis for COVID_19 because of the production of clear radiographic image quality and high-resolution and three-dimensional of a patient's chest in two views (anterior-posterior view and the lateral view). In addition to that, a CT scan is more readily and cheaper, and more available in the hospital, also it takes less time to check the patient's chest.

Keywords: computed tomography; COVID_19; lung; pneumonia.

التشخيص المبكر لمرض فيروس كورونا (كوفيد-19) عن طريق الأشعة المقطعية

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المستخلص: فيروس كورونا هو فيروس يصيب الجهاز التنفسي ويؤدي إلى الالتهاب الرئوي والفشل الكلوي ومشكلات صحية أخرى، هدفت هذه الدراسة إلى أن يكون التشخيص المبكر لفيروس كورونا في أسرع وقت للحفاظ على الخلايا السليمة للمرضى. تم فحص المرضى المصابين بفيروس كورونا الذين تراوحت أعمارهم بين (85-25) عامًا عن طريق الأشعة المقطعية والتحليل المختبري (PCR) والأشعة السينية والتصوير المقطعي بالإصدار البوزيتروني/ التصوير المقطعي المحوسب. يعتبر تشخيص فيروس كورونا بالأشعة المقطعية هي الطريقة الأكثر وضوحًا للتشخيص المبكر لفيروس كورونا؛ نظرًا لإنتاج جودة صورة إشعاعية واضحة وعالية الدقة وثلاثية الأبعاد لصدر المريض في عرضين (عرض أمامي- خلفي anterior-posterior view وعرض جانبي lateral view). بالإضافة إلى ذلك، فإن الأشعة المقطعية تكون أسهل وأرخص ومتوفرة أكثر في المستشفى، كما أنها تستغرق وقتًا أقل لفحص صدر المريض.

الكلمات المفتاحية: الأشعة المقطعية، مرض فيروس كورونا (كوفيد-19)، الالتهاب الرئوي، الرئة.

1- Introduction

COVID_19 is a group of common types of viruses, which usually affect the respiratory passages of mammals; they can infect mice, dogs, cats, horses, and livestock as they infect humans, despite the presence for some dangerous types of COVID_19, and then during the transmission for this type new from COVID_19, most of the early cases were associated with the seafood market in Southern China in Wuhan, and there is a widespread speculation that some wildlife sold there are intermediate hosts of the virus. The first cases appeared in December 2019 year in Wuhan, in central China's Hubei Province, many of the first people visited the infected or worked at the 'Hunan' seafood market in Wuhan, firstly, the disease is

spreading from animals to humans, but now it could be spread among humans from person to person. COVID_19 is a virus that infects the respiratory system, as it may cause inflammation in the lung and intestine and lead to kidney failure, also it causes acute inflammation in the respiratory system. The diagnosis of a COVID_19 using a computed tomography scan imaging to take a radiographic image of the patient's chest in view anterior-posterior (AP) and view laterally. This examination is characterising by CT scan imaging to produce a high-resolution image of chest components such as tissues, lungs, heart, bones, and ribs. CT scan for lung use high-resolution that shows more details of lung disorders, chronic lung infections, Pneumonia, lung tumours, chronic obstructive pulmonary disease, pulmonary contraction, and others. A CT scan could be viewed on a computer in two or three-dimensional, and radiographic image technologies are easy to use on a computer (Hofer, 2007; Salvatore et al., 2018). There are 6, 790, 496 confirmed cases of the new crown virus worldwide, including 396, 267 deaths, and disease outbreaks in many countries and regions. There were 645, 281 new infections worldwide. And the COVID_19 is spreading to more countries of the world, it is almost spreading all over the world.

The study problem for the current research is early diagnosis of the Coronavirus by the laboratory-analysis (PCR) in the hospitals. This laboratory-analysis (PCR) will take a long time to check the patient for more than five hours or a full day. At this time Coronavirus will be controlling the patient's body. It is necessary to diagnose the COVID_19 early by CT scan check-up before laboratory-analysis (PCR) and diagnose patients with COVID_19 by CT scan, as this will save time for patients to be treated and reduce the number of infected people with Coronavirus.

Among the study problems presented by the current research the main question is an early diagnosis of COVID_19 by CT scan. Some sub-questions can be identified:

1- What is COVID_19?
2- How an early diagnosis of COVID_19 can be performed?
3- What is a CT scan?
4- How do we do a check-up for the patient's infected chest with COVID_19?

The objectives of the current research are as follows:

1. Early diagnosis of the COVID_19 by using CT scan is the fastest time in checkups of the patient's chest.
2. The study aims at the best way to early diagnose COVID_19.
3. The study aims at health awareness in the diagnosis of COVID_19. Where the importance of the current research stems from the fact that it is recent studies in the diagnosis of COVID_19.

Theoretical importance:

1. The importance of finding a method early diagnosis of COVID_19.

2. The current research is considered one of the studies that accompany continuous studies. And to keep pace with developments in the medical diagnosis, in general. And a continuation of previous research and studies.

Practical importance: adding and presenting new scientific results that are of interest to researchers in the field of diagnosis COVID_19.

2- Material and methods

The methods of patient's check-up are PCR, X-ray, CT scan, PET/CT scan, CT scan with PCR, CT scan with X-ray and CT scan with PET/CT scan. As shown in the results.

2.1 Viruses

The last studies on viral research where viruses were discovered a century ago is related to COVID_19. These viruses cause respiratory and lung inflammation, kidney failure and other health issues with symptoms such as fever, high temperature, etc.

2.1.1 COVID_19 (Kekatos, 2020; National Health Commission of the People's Republic of China, 2020; Hope et al., 2000)

COVID_19 consists of a large family of species discovered in the middle of the last century. It affects animals, birds and humans with respiratory diseases that vary in severity from accidental cold to acute respiratory infection. In the last ten years, there were three main factions of the Coronavirus that infected the human race. In 2003, a pandemic caused by a new faction (the Coronavirus) spread in Asia, which caused its victims a severe disease, especially in the respiratory system, which the World Health Organization named Acute Respiratory Syndrome (Severe Acute Respiratory Syndrome, SARS) and called the virus the name «virus SARS-Covirus. The epidemic affected at least 8, 000 people, of whom 800 died, or 10% of the infected people. Two new factions of the virus were discovered in 2004, 2005, and in April of 2012, scientists in Saudi Arabia and Qatar discovered the sixth faction of the 'Coronavirus' and called it 'Novel Coronavirus' or 'MERS'. That is, 'COVID_19 for the Middle East' (Middle East Respiratory Syndrome MERS — CoV) found that it is very similar to the SARS virus and leads to symptoms that are not very different from those of SARS. COVID_19 is a group of viruses that cause respiratory infections, and belong to the family Coronavirus. And Coronavirus affective the respiratory system, it may cause inflammation in the lung, stomach and intestine, and causes acute inflammation in the respiratory system, and quickly leads to kidney failure. Symptoms may develop into acute lung inflammation, due to damage to the alveoli and swelling of the lung tissue, as the virus may prevent oxygen from reaching the blood, causing impairment in the functions of body organs, which may lead to death in certain cases.

➢ Symptoms COVID_19 include: Fever, cough, high degree of heat, and shortness of breath.

➢ Prevention of COVID_19: Hand washing with soap and water, be sure to wear masks in crowded places, drink plenty of fluids, avoid contact with wild animals and farm animals.

2.2 Pneumonia

Pneumonia: pneumonia causes chest pain, coughing, fever or hyperthermia, and dyspnea. The inflammation causes difficulty in the passage of oxygen through the air sacs in the bloodstream. Ground-glass opacity GGO: it is showing signs of diffuse pan bronchiolitis and blood vessels leading to pneumonia and kidney failure. The diagnosis of pneumonia or GGO is performed by taking a radiography photo for the patient's chest by CT scan.

2.3 Radiography for lung (Hofer, 2007; Salvatore et al., 2018; Das, 2015; Dale et al., 2015; Hofer et al., 2006)

A chest X-ray is routinely performed from the posterior view to the anterior view and it is usually taken from lateral view. It usually can show a serious disorder in the lungs or chest wall, including ribs such as, chest X-ray images that can show most lung infections or tumours lung or chronic obstructive pulmonary disease or pulmonary contraction or fluid and other lung's cases. Although chest X-ray rarely provides enough information to find the exact cause of the problem (Hofer et al., 2006).

A computed tomography (CT) provides more detail than simple X-rays. With CT, a series of computer X-rays are analysed providing multiple views at different levels, such as longitudinal sections and transverse sections. During this CT, a visible material be may injected with X-rays (called the radioactive contrast agent or shady material for radiation) into the bloodstream, or given by mouth to help clear up some anomalies in the chest. Using high-resolution CT scans are more specialised CT, with high-resolution CT providing more detail about lung disorders, while spiral CT gives three-dimensional images. CT angiography uses a radioactive contrast agent by intravenous injection into the arm to visualise blood vessels, including imaging the artery that transports blood from the heart to the lungs (pulmonary artery). Currently, CT angiography is usually used instead of nuclear lung imaging to diagnose blood clots in the pulmonary artery (pulmonary embolism) (Hofer, 2007; Salvatore et al., 2018).

Magnetic resonance imaging (MRI) also gives very detailed images, which are very useful in diagnosing the presence of vascular anomalies in the chest, such as aortic aneurysm; but MRI takes time and cost more than CT scan. Also, the result of MRI is less good than CT in diagnosing abnormalities of the lungs, so MRI is not usually used for chest imaging. CT scan is the best use in diagnosing COVID_19 from X-ray and MRI.

CT (PET) scan and CT scan are often joined to show lung. PET-CT is a test that combines positron emission tomography (PET) scan with CT scan to produce an exact picture of a specific area of the body (Dale et al., 2015).

PET screening uses a radioactive device that gives radiation to show biochemical activity in the body like cells that break down glucose. CT gives a detailed picture of the organs, bones, and tissues.

For PET/CT scan lung scanning,

1. It is injected intravenously with a small amount of glucose-containing radioactive track material about an hour before the examination. Most often, a fluorine analogue is used and then taken temporarily needle inside the vein, but the procedure is painless.

2. Once in the bloodstream, the trace substance accumulates in the lungs and the organs and tissues and begins to release energy in the form of gamma rays.

3. The PET/CT scan scanner detects these rays and creates detailed images of them.

4. The images can show the lung's structure and help in lung diagnosis, lung cancer and pneumonia, etc. (Das, 2015).

2.4 CT scan (Hofer, 2007; Salvatore et al., 2018)

CT scan is an X-ray imaging test to produce detailed images of internal body organs. During the test, the patient lies on a bed attached to the imaging device. Then the device sends an X-ray through the region that is photographed in the body. All areas of the body could be photographed, such as the head, neck, chest, abdomen, and others. CT images are so accurate that they contain more detail than a regular X-ray image. The images are converted to a special computer, which analyses the images and restarts them again, by showing different sections transverse or longitudinal. Sometimes, a contrast material uses a material that gives a bright white colour in the pictures. Contrasting material could be inserted into the body intravenously, orally, or even the anus it comes to the purpose of the test and the organ being tested. Contrast helps to see pictures more clearly. Iodine is often the contrasting substance, but other substances are used.

For CT scan lung scanning, the patient will lie on the examination table moving in and out of the device. Most of the time, the patient lies on a back with arms raised behind the head when possible. Once you are inside the device, the X-ray tube rotates around you non-stop, the patient can even hear the sound of movement, but it is not loud. A special computer that processes and produces data in cross-section sections. These images could be stored, viewed on a screen, or printed on film. three-dimensional models of the lung area could be made by grouping the slides.

3- Results and discussion

The diagnosis of COVID_19 in this study was conducted by CT scan. Also it was considered as a check-up for COVID_19 patients whose ages were between (85−25) years by CT scan and laboratory-analysis (PCR) and X-ray and PET/CT scan.

Case 1 CT scan and PCR imaging of the COVID_19

A male patient aged 63 years old, who suffers from acute coughing, pain, dyspnea, and hyperthermia in the patient body, patient check-up was done by CT scan for early diagnosis of COVID_19 and as shows in Figure 1(a).

Figure (1) (a) Pneumonia (b) Image PCR (COVID_19)

This radiographic imaging shows that the patient has acute pneumonia in the lungs as the patient is in reservation in medical quarantine and he was checked by laboratory-analysis and as shown in Figure 1(b).

#	Name	Flu A	H1N1pdm09	H3N2	Flu B	COVID-19
		Negative	Negative	Negative	Negative	Positive

(b)

The patient's diagnosis made by reverse transcription polymerase chain reaction or DNA check-up and results showed that the patient is positive which means the patient is infected by COVID_19 and was the outcome takes less than five hours. The main method used in China to detect emerging COVID_19 infections is the technique reverse transcription polymerase chain reaction and DNA check-up. This technique can detect Coronavirus originating from a patient's blood or in samples from his respiratory system, such as the nose and throat.

Case 2　X-ray and CT scan imaging of the COVID_19

A female patient aged 70 years old suffers from acute coughing, pain, dyspnea, and hyperthermia in the patient's body. Where the patient chest was imaged X-ray in an AP view, and lateral view and as shown in Figure 2(a).

It shows coarsening lung markings for the patient in imaging X-ray and the patient check-up done by CT scan and as shown in Figure 2(b).

Then it was found that the patient is infected with GGO in the lungs and also shows that a CT scan is more clear than an X-ray in the diagnosis of COVID_19 because of the formation of a high-resolution radiographic image and with more clarity for anatomy the chest and lungs.
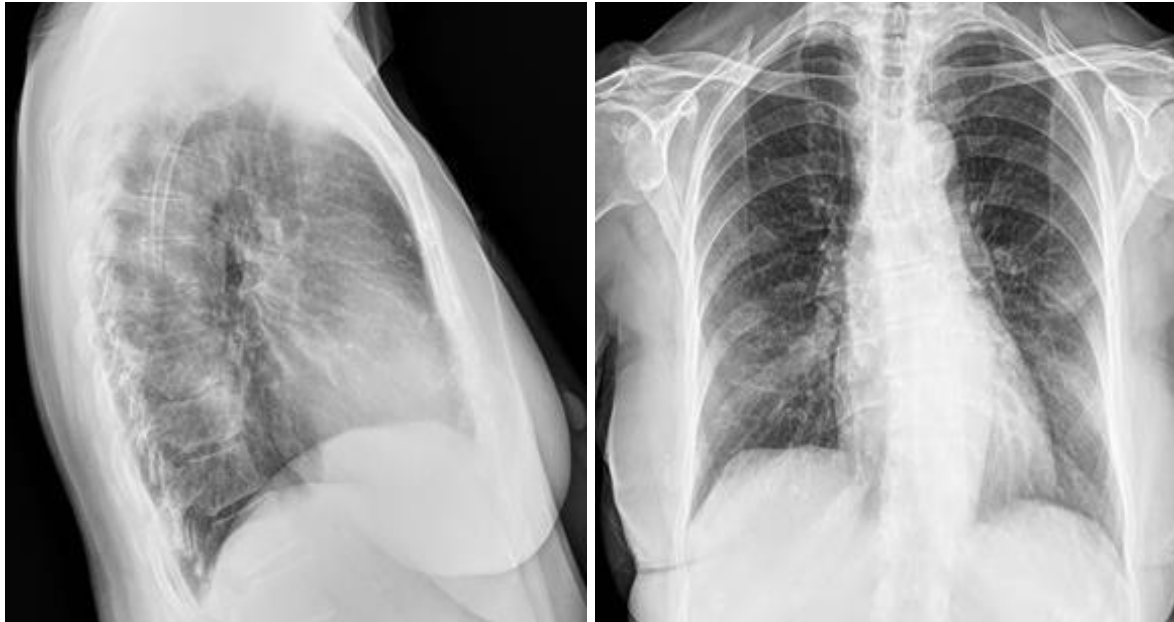

Figure (2) (a) A X-ray for the COVID-19 of lungs (b) COVID-19 in both lungs Source: Macori (2020)

(a)   (b)

Case 3   CT scan imaging

A female patient aged 79 years-old who suffers from dyspnea, acute coughing, pain, and hyperthermia, as checkup patient was done by computed tomography scan and as shows in the image.
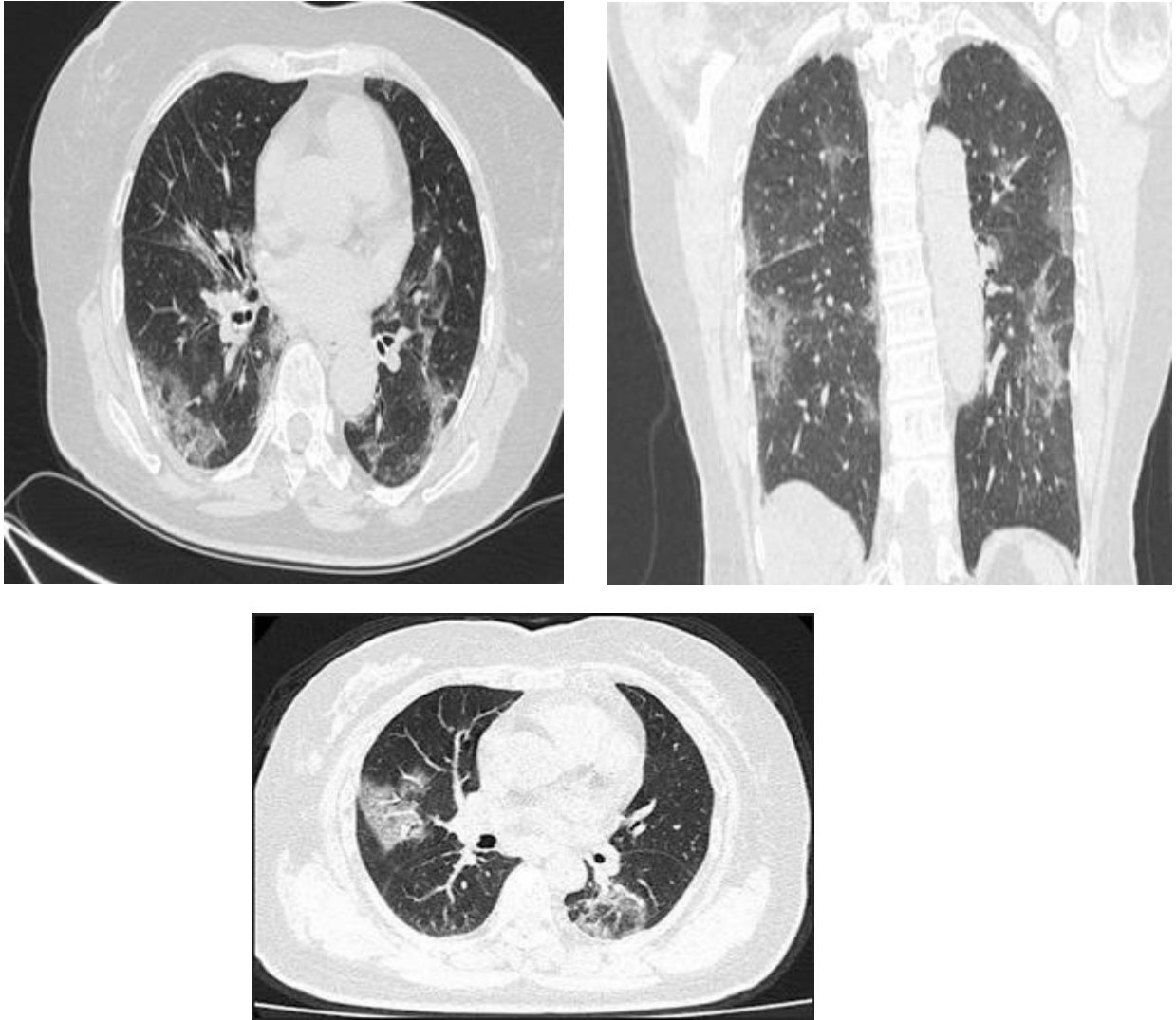
Figure (3) Image CT scan (GGO) *Source:* Website ITN (2020a)

CT scan image has been taken for patient and image shows that the patient has GGO in lungs (COVID_19).

Case 4 CT scan imaging of the GGO

A man patient aged 65 years old who suffers from acute coughing, pain, and hyperthermia in the patient body, and where the patient is check-up by computed tomography scan for early diagnosis of COVID_19 and as shows in Figure 4.
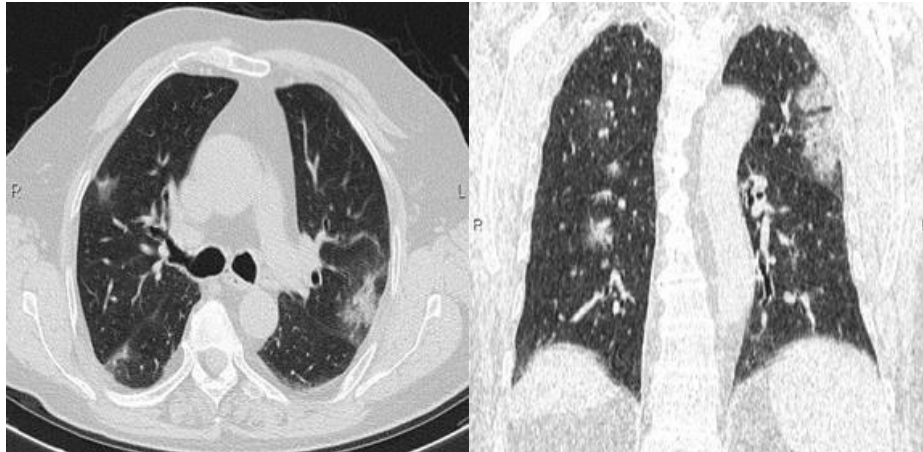
Figure (4) Shows (GGO) in both lungs   *Source:* Niknejad (2020b)

CT scan image has been taken for patient and image shows that the patient has GGO in both lungs.

Case 5 CT scan imaging for patient with GGO in left lung

A male patient aged 55 years old, who suffers from pain, hyperthermia in the patient body, and acute coughing, and the check-up of the patient was by computed tomography for early diagnosis of COVID_19 and as shows in Figure 5.
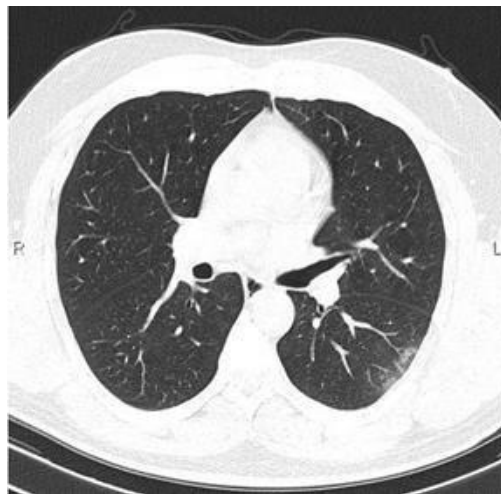

Figure (5) Shows GGO in the left lung lower lobe   *Source:* Niknejad (2020a)

A computed tomography image has been taken for the patient and image shows that the patient has GGO as it seen at left lung lower lobe.

Case 6 CT scan imaging for patient with GGO in lungs

A female patient age 33 years old who suffers from acute coughing, pain, dyspnea, and hyperthermia in the patient body, and the patient's check-up done by Computed tomography and as shows in Figure 6.
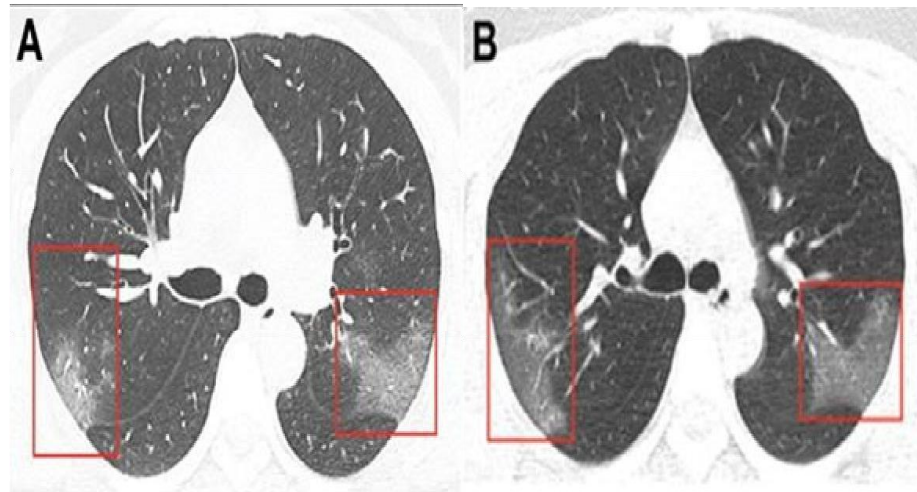
Figure (6) CT scan for COVID-19 of the lungs (see online version for colours) *Source:* Lei et al. (2020)

A CT scan image was taken for patient and Image shows GGO in lungs (COVID_19).

Case 7 CT scan imaging of patient infected with GGO

A male patient aged 80 years-old, who suffers from acute coughing, pain, and hyperthermia in the patient's body, and the patient checkup done by computed tomography scan and as shown in the Figure 9.
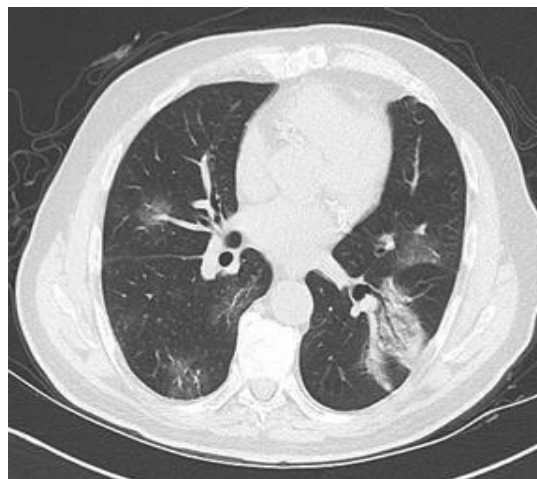

Figure (7) Shown COVID-19 in the left lung lower lobe   Source: Cetinoglu (2020)

A CT scan image has been taken for the patient and image shows that the patient has GGO as it seen at left lung lower lobe.

Case 8 CT scan imaging for GGO in both lungs

A male patient aged 70 years old who suffers from pain, dyspnea, and hyperthermia in the patient's body, and where the patient is check-up for early diagnosis of COVID_19 by Computed tomography and as shows in Figure 10.
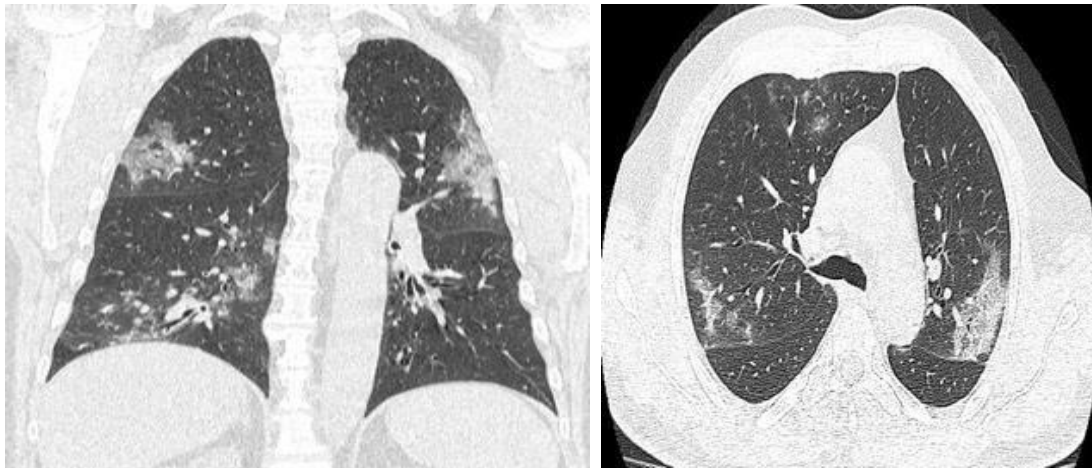
Figure (8)There GGO in both lungs   *Source:* Rasuli (2020)

A CT scan image has been taken for the patient. And image shows that the patient it has GGO with peripheral distributions as shown in both lungs.

Case 9 CT scan imaging for patient infected COVID_19

A male patient aged 29 years old who suffers from acute coughing, pain, dyspnea, and hyperthermia in the patient body, and the early diagnosis of patient check-up of COVID_19 has been done by Computed tomography and as shows in Figure 9.
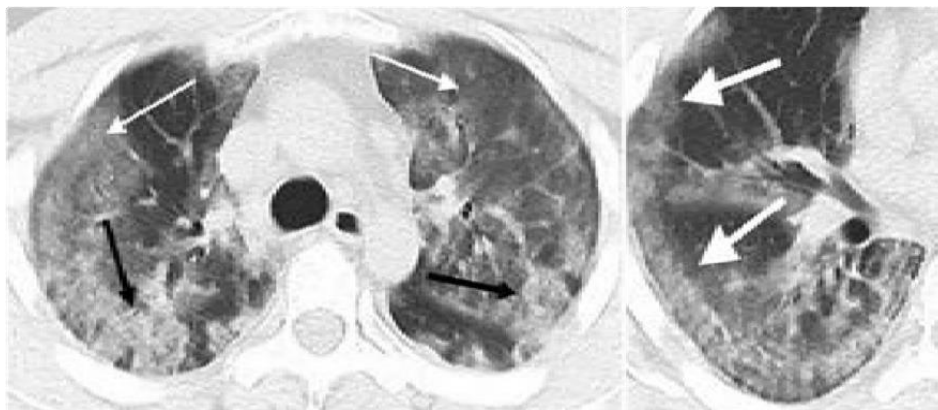

Figure (9) Shows infection with COVID-19   Source: Website ITN (2020b)

A CT scan image has been taken for the patient and shows GGO in lungs and pulmonary opacities and the patient is infected COVID_19.

Case 10 CT scan image for patient with GGO

A male patient aged 47 years old who suffers from hyperthermia, pain, acute coughing, and dyspnea in the patient body, and where the patient is check-up by Computed tomography and as shows in Figure 10.

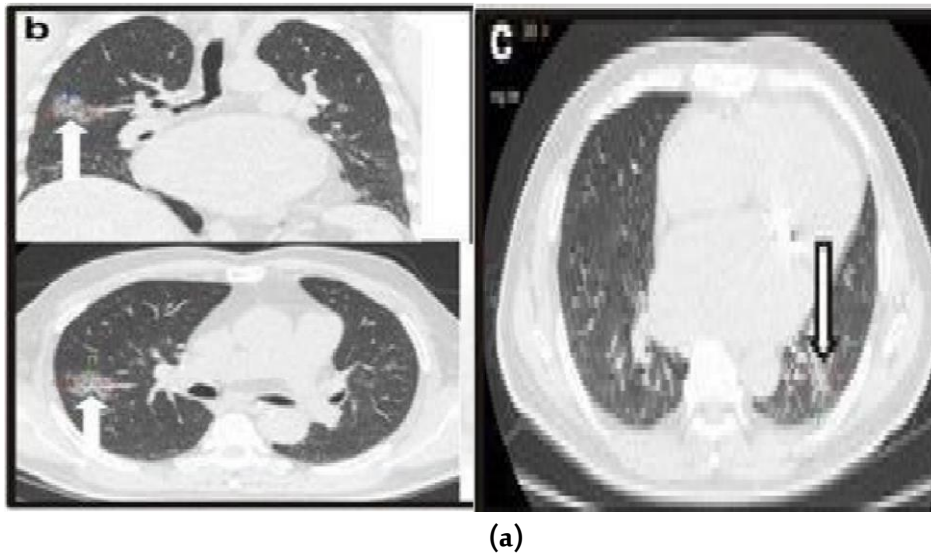**Figure (10) Shows GGO and COVID-19 (see online version for colours)**

(a)   (b)   (c)

(d)
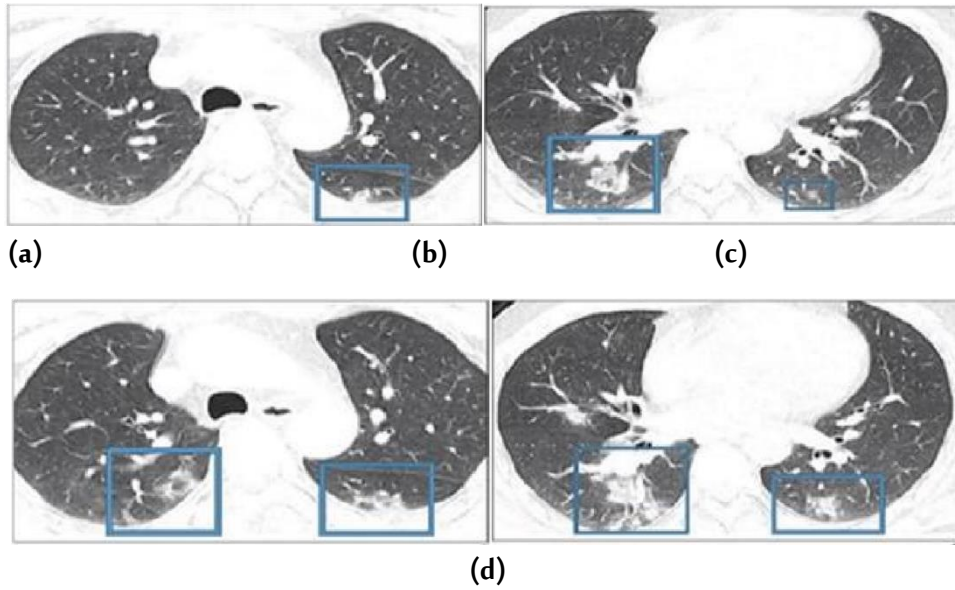
Source: Website ITN (2020a)

A CT scan image has been taken for patient and Image shows GGO in lungs (COVID_19).

Case 11 CT scan and PET/CT scan imaging of the COVID-19

A male patient aged 47 years old who suffers from acute coughing, pain, dyspnea, and hyperthermia in the patient body, and where the patient is check-up by Computed tomography and as shows in Figure 11(a).
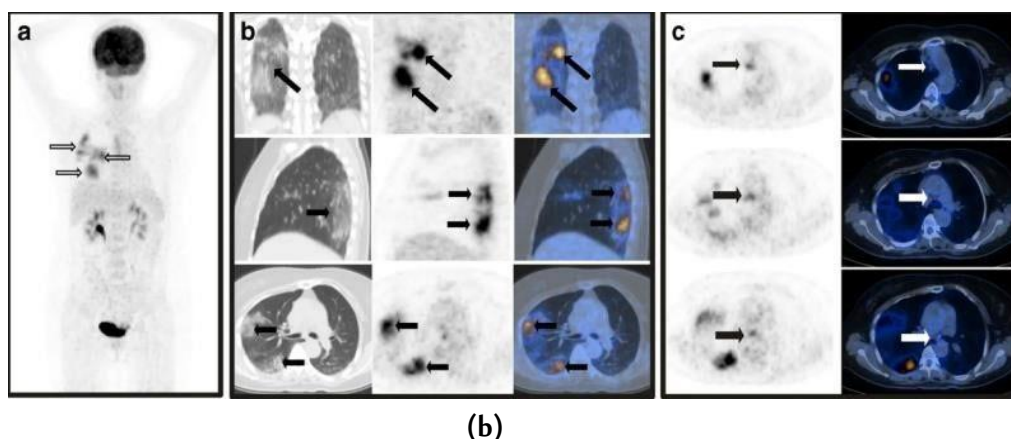

(a)

(b)

Figure (11) (a) Shows COVID-19 (b) Image PET/CT scan for (COVID_19) (see online version for colours)   Source: Qin et al. (2020)

Also shows that a PET/CT is more clear that a CT scan. And just PET/CT takes more time to diagnose patients the COVID_19.

Discussion

The study was aimed to assess the early diagnosis COVID_19 by CT scan in five cases:

1- Diagnosing COVID_19 with a laboratory analysis (PCR) takes more than five hours. While Corona patient's diagnosis with a CT takes less than half an hour, in this case, the CT scan is used for the early diagnosis of COVID_19 because it will save patient's lives and save more time to give the right treatment for the patients.

2- CT is more efficient, cheaper, and more accessible and available in the hospitals and in the world than PET/CT scan, and CT.

3- PET/CT scan is less efficient and less available in a hospital and in the world than CT.

4- PET/CT scan is imaging that has a clearer image quality radiographic than the image quality of CT scan.

5- CT is a less time-consuming method for examining patients with COVID_19 (pneumonia) from laboratory tests and PET/CT scan.

4- Conclusions

To have an early diagnosis of the COVID_19 in the fastest time in two cases:

1. The early diagnosis of the COVID_19 by CT scan.

2. After proving that patient with COVID_19 through CT scan passes through its stages: laboratory tests, medical quarantine and psychotherapy, and PET/CT scan (if he needs for check patient)

and after completing check follow for the patient's health, this stages for gaining more time and for keeping up more general health for patients.

Recommendations

I suggest that the best way for early diagnosis of COVID_19 is the CT scan because CT is the clearest method and the fastest time for diagnosis COVID_19 from laboratory tests. And CT is the fastest time, less efficient and more available in hospitals and in the world more from PET/CT scan.

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Abbreviations

COVID_19   Coronavirus Disease 2019

GGO   Ground glass nodules

PET/CT   Positron emission tomography/computed tomography scan

CT   Computed tomography Scan

MRI   Magnetic resonance imaging

PCR   Polymerase chain reaction