

Original Article: Advantages and disadvantages of CT scan in diagnosing Corona disease

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ABSTRACT

In X-ray (radiography), radiation is used to produce a 2-dimensional image. Usually in hospitals using fixed equipment by radiographers, they can also be done in portable devices. In CT scanning, a computer is used to merge 2-D X-ray images and convert them into a 3-D image. They require highly specialized equipment and are performed by a radiographer in a hospital. In ultrasound scans, high-frequency sound waves are used to produce images. These can be done in hospitals or other medical facilities such as a doctor's office. Recent research has shown that the sensitivity of CT scan to detect the Covid-19 infection is 98%. While the sensitivity of the RT-PCR method is 71%. In a study published in the radiology journal, CT scan of the chest was performed in addition to laboratory tests on more than 1000 patients to diagnose Corona disease. The results of this research indicated that CT scan should be used as a primary screening tool for the Corona virus. In general, in connection with diseases for which there is no specific medicine or vaccine, such as the infection caused by the virus that causes the Corona disease, it is necessary and vital to diagnose the disease in the early stages and quickly separate the infected person from the healthy population.

Introduction

According to the latest guidelines published by the Chinese government [1-3], the diagnosis of the Covid-19 virus should be confirmed by the molecular method of reverse transcription polymerase chain reaction (RT-PCR) or gene sequencing on respiratory or blood samples as the main indicator in the hospital [4-7]. However, the limitations of sample collection and its transfer as well as the performance of the kit [8-11], the

sensitivity of the RT-PCR molecular method in throat swap samples in the initial tests has been reported as 30-60% [12-15]. In the current public health emergency, the low sensitivity of RT-PCR means that a large number of patients with Covid-19 are not being detected quickly and may not receive appropriate and necessary medical care. Also, due to the highly contagious nature of the virus, there is a greater risk of contracting the population [16-19].

Early diagnosis of the Covid-19 virus is very important for medical care and disease control.

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CT scan of the chest compared to RT-PCR can be a more reliable, practical and quick method for diagnosing and evaluating the Corona disease, especially in areas where this disease has spread [20-22].

CT scan provides high-quality and accurate images of the patient's bones and internal organs [23]. By performing a CT scan of the lungs, radiologists can detect the presence of dark spots or bright spots in the patient's lungs. In the diagnosis of Covid-19, a CT scan of the lungs of a patient suspected of infection can show hazy abnormalities that accumulate in the outer parts of the lungs [24-29]. These abnormalities are more commonly known as vitreous opacities. With these images, doctors can partially detect the Covid-19 infection that has penetrated deep into the lungs. This infection may not be detected by PCR test [30].

The advantages of CT scan in the diagnosis of Corona disease include the following

- Easily accessible and fast scanning with immediate results;
- More sensitive than some PCR tests and may remain positive as infection evolves [31].

One of the important disadvantages of CT scan in the diagnosis of Corona disease is that it can produce false negative results, especially in the early stages of infection. In turn, this may give people false reassurance and cause them to avoid proper isolation [32-35]. Finally, the risk of infecting other members of the community increases. False positive results may also occur. The results of CT scan of other diseases can be similar to the results of CT scan of lungs of Covid-19 [36-39].

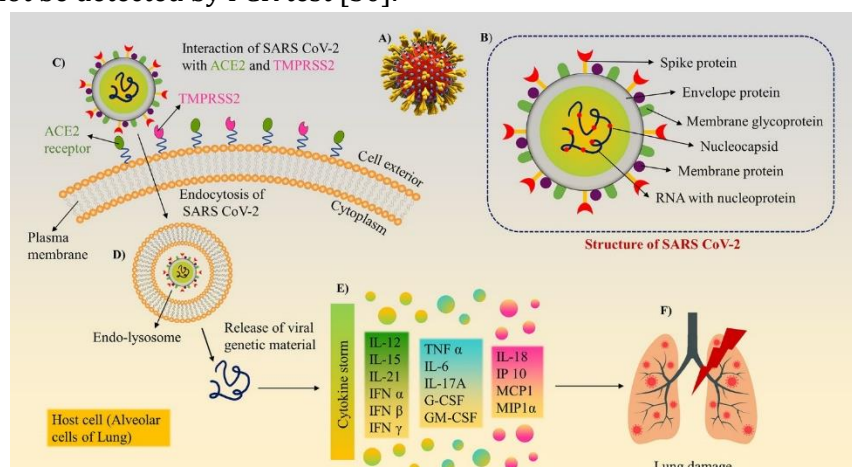


Figure 1. A Recent Update on Advanced Molecular Diagnostic Techniques for COVID-19 Pandemic

When can we be sure of the results of the lung CT scan in Corona disease?

Even when PCR tests are available, imaging tests for Covid-19 are useful under the following conditions: CT scan can be a suitable solution to diagnose suspicious cases [40-45]. Things that are not shown in the PCR test. In some CT scan centers, some Corona patients whose first PCR test was negative have been diagnosed with infection in the CT scan test. Imaging tests, especially CT, can help detect complications of

Covid-19 in known cases. Such as revealing the severity of the disease, checking for other infections [46-49], showing blood clots in the lungs (pulmonary embolism) and showing signs of heart failure [50].

The role of CT scan in the future

Radiology researchers are seriously investigating possible long-term effects of Covid-19, such as possible scarring of the lungs. Imaging research could help identify how Covid-

19 affects blood vessels in the lungs. Finally, it explains why low oxygen occurs in Corona patients [51-55]. Studies on CT scans of the lungs can help the medical community understand and combat possible complications that appear in people infected with the Corona virus [56].

Limitations of CT and chest X-ray in the diagnosis of Covid-19

The American College of Radiology (or ACR) has advised its nearly 40,000 practicing radiologists that CT and X-rays should not be used as a first-line tool to diagnose or screen for Covid-19 [57].

There are three main reasons for recommending ACR

- A CT or chest X-ray cannot accurately differentiate between Covid-19 and other respiratory infections such as seasonal influenza. Unlike swab tests that lead to specific diagnoses of Covid-19, imaging findings are not accurate enough to confirm Covid-19 [58-60]. They can only refer to the symptoms of infection. These symptoms can be caused by other reasons, including seasonal influenza, which is very common in some seasons of the year.
- A significant percentage of patients with Covid-19 have a normal CT scan and chest image. For those patients, a normal imaging result can falsely convince them that they are healthy. If they believe they are healthy, they expose others to the Corona virus.
- Because Covid-19 is highly contagious, the use of imaging equipment on Covid-19 patients poses a serious risk to health care providers and other patients. CT scan is a big and complicated machine. They should be thoroughly cleaned between the CT of the next potential Covid-19 patient. But even with thorough cleaning, there is a

risk that the virus will remain on the surface of the CT scan room. In addition, the transfer of potential Covid-19 patients into the CT scan room increases the risk of spreading the virus in medical centers. It also means that fewer CT scanners are available for other vulnerable patients who need imaging tests.

By conducting a study, researchers compared the diagnostic power of CT scan with RT-PCR test in the diagnosis of Covid-19 patients. This study was conducted by reviewing the files of 569 patients who were admitted to one of Kermanshah hospitals from July to March 2021. The results of this study showed that 84% of people had a positive CT scan and nearly 85% of people had a positive RT-PCR result. In this study, the sensitivity, specificity and accuracy of CT scan were reported as 88.7%, 64.8% and 80.1% respectively [61].

The sensitivity of CT scan was nearly 90% in people under 60 years old and 83% in people over 60 years old. Also, the accuracy of this test was reported to be 84.7% in women and 78.7% in men. Finally, the investigations of this study indicated that the accuracy of CT scan in patients with Covid-19 is high. Of course, CT scan cannot definitely diagnose or rule out Covid-19. However, CT scan can be used as a quick tool. In conducting this study, Alireza Janbakhsh, Farzaneh Saberi, Zahra Naghibifar; Researchers from Kermanshah University of Medical Sciences and Armin Naghipour from Yazd University of Medical Sciences collaborated with each other [62].

The findings of this study have been published in the journal of Mazandaran University of Medical Sciences in the form of a scientific article entitled "Investigation of the diagnostic power of CT scan compared to RT-PCR test in the diagnosis of Covid-19 patients" in August of this year.

The magnetic resonance imaging device is based on the spin movement of the nuclei of hydrogen

atoms in the body. A hydrogen atom has only one proton in its nucleus. Such a nucleus has an angular momentum, which is called MR. The angular momentum causes the movement of this nucleus, and as a result of the movement of the nucleus with a positive electric charge, a magnetic moment is also produced. By placing these nuclei in an external magnetic field, all the nuclei are placed and arranged in one direction under the influence of the field [63].

An MRI imaging scanner uses strong magnets and radio wave signals that can cause heating or possible movement of foreign or internal metal objects. Therefore, it is important to tell the radiologist if you have any of the following:

Heart pacemaker;

Middle ear prosthesis;

Cochlear implant in the ear;

A clip used to control a brain aneurysm;

Stimulator of the vagus nerve [64];

Metal parts in the head or inside the eyeball.

Leave all jewelry, watches, credit cards, electronics such as cell phones, hearing aids, body piercings, dentures, etc. at home. You should not be fasting to do a simple brain MRI. But if you need to inject a contrast agent, you must not eat anything for three hours before.

Take your medications as usual unless your doctor tells you otherwise. If you are pregnant, cannot lie on your back for 30-60 minutes, or suffer from claustrophobia (fear of closed or narrow spaces), be sure to inform in advance [65].

Duration of brain MRI

A brain scan can take about 30 minutes to an hour. More time may be needed if contrast material is injected. During the test, it is important that you remain still to get the clearest images. For this reason, children are given sedatives if necessary. If necessary, the injection of contrast material is done first, and then you lie on a table that goes into the MRI machine [66].

The technician will take several pictures of your brain, each lasting a few minutes. During the MRI, you may hear certain sounds that are completely normal and caused by the operation of the machine [67].

Care after brain MRI

After the test, you can get dressed and leave the imaging center. If you are sedated, the staff may move you to recovery until you wake up. After ensuring that vital signs are normal, you can immediately return to daily activities. If you have received a contrast injection, you may feel a little nauseous, have a headache, or have muscle cramps. These symptoms are normal and will disappear after a few hours. Of course, drinking lots of fluids is also very helpful [68].

The difference between brain CT scan and brain MRI

Basically, a CT scan of the brain uses a specific dose of X-rays to create images. While brain MRI uses a magnetic field to produce accurate images of soft tissues. For this reason, MRI is considered a less dangerous method, and at the same time, the clarity and sensitivity of its images are also higher [69].

Although the cost of brain MRI is somewhat higher than CT scan, it is a better option for people with pacemakers, nerve stimulators and cochlear implants or children who need multiple scans because babies and children are more vulnerable to X-rays [70].

What is MRI with injection?

Some magnetic resonance imaging involves injecting a contrast dye, which makes certain tissues and blood vessels show up more clearly and in more detail. Sometimes contrast dye can cause side effects (such as feeling sick, skin rash, headache, and dizziness). These side effects are usually mild and do not last long. Contrast dye may also cause tissue and organ damage in people with severe kidney disease. So, if you

have a history of kidney disease, a blood test may be taken to determine the level of kidney function and the safety of the scan [71].

Laser is able to cut the hardest parts of the body like a knife and can be used in almost all surgeries, if it does not have the side effects of knife surgery and does not leave a cut. In laser surgery, wound healing is done better and faster, and less destruction occurs in the treatment area. The application of laser in the treatment of skin diseases and beauty has gained a special place with the arrival of new and advanced devices. The laser heats up and eventually destroys some sensitive tissue molecules. Considering that the wavelength of the laser is known, it affects only certain structures. Laser is used in the treatment of skin diseases, lesions and moles, excess hair, wrinkles, depressions and scar removal. A specific wavelength of laser is needed to treat each of these cases [72].

Preparation before brain MRI

In the MRI of the patient's body, which is full of hydrogen nuclei, due to the presence of water molecules in the body, when the radiation is irradiated, the nuclei are all arranged and return to their original state after the radiation is stopped [73].

This change in the magnetic field creates an electromagnetic wave. This new wave is sent out from each proton and received by the receivers of the device to the specialized computer of the device. The computer, which has a high computing power, after analysis, sends the images to the monitor [73-76], which can finally be printed by the printer. In the parts where more waves are emitted, the density of protons is higher and, as a result, the water in the body is higher [77-80]. From the concentration of water in the patient's body, accurate images of tissues can be obtained, and by comparing with healthy tissue, the final diagnosis is announced by the doctor.

The difference between CT scan and MRI

In general, what makes a CT scan different from an MRI is the radiation and resources used by these two devices. MRI works with radio waves and CT scan with X-rays [81-84]. On the other hand, MRI usually has a longer process than CT scan. MRI is better at showing details than CT scan. MRI costs more and the device is noisier [85-87].

Types of MRI

By examining the types of MRI, we can understand what MRI is for and what valuable information about diseases is provided by magnetic resonance imaging [88-90].

MRI of the brain and spinal cord

Usually, in MRI of the brain and spinal cord, valuable information is obtained about the following:

How is an eye MRI? Advances in optical imaging techniques designed for the eye, such as scanning laser polarimetry [91-93], confocal scanning laser ophthalmoscopy, and optical coherence tomography, have made it possible to examine the internal features of the eye [94-96]. However, although these devices provide high-resolution information, these technologies can obtain limited information beyond the surface of the retinal pigment epithelium [97-99]. Other techniques developed for imaging other parts of the body, such as ultrasound and magnetic resonance imaging, also have the potential to provide clinically relevant information, especially in cases where it is not possible to obtain the required information optically [100-102]. Many new magnetic resonance imaging techniques have been applied in ophthalmology and provide structural, physiological and functional information that can be useful for clinical diagnosis and treatment [103-105].

Conclusion

Magnetic resonance imaging can be done in any part of the body. A lumbar MRI specifically examines the lumbar spine (the area where back problems usually originate). Lumbosacral spine consists of five lumbar vertebrae (L1 to L5), sacrum (bony shield at the bottom of the spine) and coccyx. The lumbosacral spine is also composed of large blood vessels, nerves, tendons, ligaments and cartilage.

An MRI specialist may recommend magnetic resonance imaging to better diagnose or treat spine problems. Pain, disease, infection, or other injury-related factors can cause disease. If you have the following symptoms, your doctor may prescribe an MRI of the back and pelvis:

- Back pain with fever;
- Congenital defects that affect the spine;
- Damage to the spine;
- Persistent or severe back pain;
- Multiple sclerosis;
- Bladder problems;
- Symptoms of brain or spine cancer;
- Weakness, numbness or other problems in the legs.

If spine surgery is planned, the doctor may also order a lumbar MRI. MRI of the back creates the opportunity to plan the surgery before the incision is made.

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