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Original Article

Medical Diagnosis Using Positron Emission Tomography (PET/PET-CT)

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Abstract

The increasing role of positron emission tomography (PET) in the diagnosis and staging of malignant disease and monitoring of therapy response can be attributed to significant improvements made in the performance of this imaging technology. Anticipated progress is frequently constrained by the physics of PET, and current designs of PET scanners aim at an ultimately high spatial resolution and sensitivity as well as improved signal-to-noise properties. Recent advances in the field of PET instrumentation include the introduction of novel scintillation crystal technology and detector electronics, as well as the widespread introduction of fast and efficient, iterative image reconstruction algorithms for fully three-dimensional (3D) PET data sets. These advances have led to a dramatic reduction in clinical imaging times while improving image quality. Finally, the combination of functional imaging and computed tomography (CT) within a combined PET/CT tomography provides a tool to accurately localize functional abnormalities in an anatomical context.

Keywords: Medical Diagnosis, Positron Emission, Tomography

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Introduction:

1.1. Medical diagnostic imaging

The term medical diagnostic imaging refers to the techniques and processes used to obtain images of the human body (or parts of it) for diagnostic, therapeutic or research purposes. It is considered a branch of biological imaging and closely collaborates with radiology, endoscopy, and thermography. Some methods of physiological measurement and recording are considered a type of medical imaging, even if they do not produce images, as is the case in electroencephalography (EEG) or magnetoencephalography (MEG), but they produce data in the form of maps. In medical terminology, medical imaging is generally equivalent to radiology, and the medical technician responsible for performing medical imaging operations is called a radiologist. [1]

(2-1)Modern medical imaging techniques

1. **Laparoscopy**

Also known as endoscopic X-ray imaging, it is usually used to determine the type and extent of bone fractures in emergency cases. By using a contrast material such as barium, this method can also be used to image the stomach and colon, thus helping to diagnose ulcers or detect colon cancer and many of its diseases.[2]

2. **Cross sectional imaging**

CT scanning is a method of obtaining an image of a single plane or section of an object. There are several types of it:

Linear CT scan: It is one of the simplest types of CT scan. The X-ray tube moves from point (A) to point (B) above the patient, while the radiation receiver moves simultaneously under the patient from point (B) to point (A), where the axis point is placed in the area of interest in being x-rayed. In this case, the areas above and below the iliac level will have blurry images. This method is no longer used and has been replaced by computed tomography.

Multi-CT: It is a combination of CT scan. In this method, several geometric movements are programmed, such as movement along an ellipse, a circle, the shape of the letter 8, and a parabola. Philips produced one of these devices, which it called 'Polytome', but it is no longer used now and has been replaced by programmed CT scanning.

Programmed tomography (CT): Also known as programmed axial tomography (CAT), it is a helical scan that produces two-dimensional images of every thin section in the body. X-rays are used, and it is not recommended to repeat this imaging frequently in order to avoid health effects. [3[

3. **Ultra sound waves**

Ultrasound imaging uses high-frequency waves ranging from 2 to 10 megahertz, which are reflected by body tissues at different angles to produce two-dimensional images, usually on the monitor screen. This method is often used to monitor the fetus in pregnant women. Some other important uses include imaging the internal organs, the heart, the male reproductive organs, and the veins of the legs. Although this method provides less anatomical information than other imaging methods, such as CT or MRI, it has many advantages that make it one of the best diagnostic tools in many cases, especially cases that include studying the functions of moving organs in real time. It is also safe to use this method, given that the patient is not exposed to any radiation influence and it has not been proven that ultrasound caused any health symptoms. This method is also relatively cheap and fast.[4]

4. **Fluoroscopy**

Fluoroscopy produces live images of the body's internal organs in the same way as radiography but employs fixed X-ray input. A medium such as barium, iodine, and air is used to show internal organs in action. The fluoroscopic method is used in operations under imaging when there is a need to obtain information about internal organs during the operation.

Figure (1-1): The fluoroscopic device and the resulting image.

1. **Magnetic resonance imaging (MRI(**

MRI uses powerful magnets to polarize a hydrogen nucleus (a single proton) in water molecules in human tissue, creating a captureable signal that is decoded into an image of the body. MRI uses three types of electromagnetic fields: a very strong static magnetic field (several Tesla units) to polarize hydrogen nuclei, called the static field; a weaker, time-varying field (1 kHz) for special coding. , called the tilt field, and a weak radio wave field in order to manipulate hydrogen nuclei to produce measurable signals that are collected through the radio wave antenna. As with CT scans, MRI produces images of thin sections and slices of the body and is therefore considered a type of CT scan. Modern MRI machines are able to produce three-dimensional images, which is a generalization of two-dimensional images. Unlike X-ray imaging, MRI does not use any type of ionizing radiation and therefore is not associated with health risks, as it is not known that there are any health risks at the long-term level of exposure to a strong static magnetic field, but this matter is still a matter of debate and research. scientific. Therefore, there is no limit to the number of times a patient can be exposed to an MRI, unlike an X-ray. However, there are health risks resulting from heating tissues by exposing them to the radio wave field and affecting devices implanted within the body, such as heart pacemakers. Given that CT and MRI imaging methods differ in their sensitivity to different tissue materials, the images resulting from both methods differ significantly. [4,5]

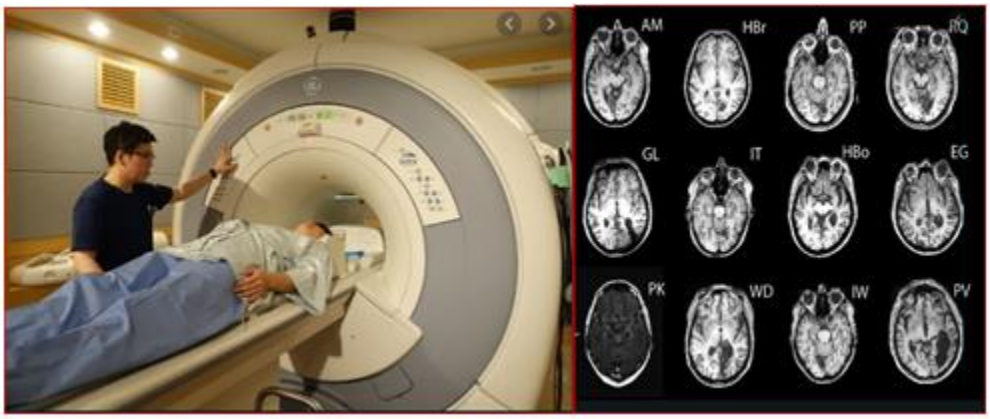

Figure (1-2): A picture of the MRI device and the resulting imaging

6.Nuclear Imaging

Nuclear medicine is a section of general medical imaging in which radioactive isotopes are used to image and evaluate the functions of the body's organs. These radioactive isotopes are usually injected into the body intravenously, taken orally, or inhaled if we use radioactive gases. Today, nuclear medicine has become one of the indispensable specialties in the patient's treatment plan from a diagnostic and therapeutic standpoint, and the aim of the events is to learn about the latest scientific developments in this regard. It is called nuclear after the nucleus of the atom, which is the source of the radiation emitted by these radioactive materials. Nuclear imaging is described as the most important peaceful

application of nuclear physics and one of the most important accurate medical methods for diagnosing and treating a number of tumors and diseases, in addition to the possibility of detecting a number of pathological changes in a way that was not previously available, as nuclear imaging relies primarily on detecting a functional defect in any organ. As a result of certain chemical changes, which contributes to diagnosing the disease in its early stages.[5]

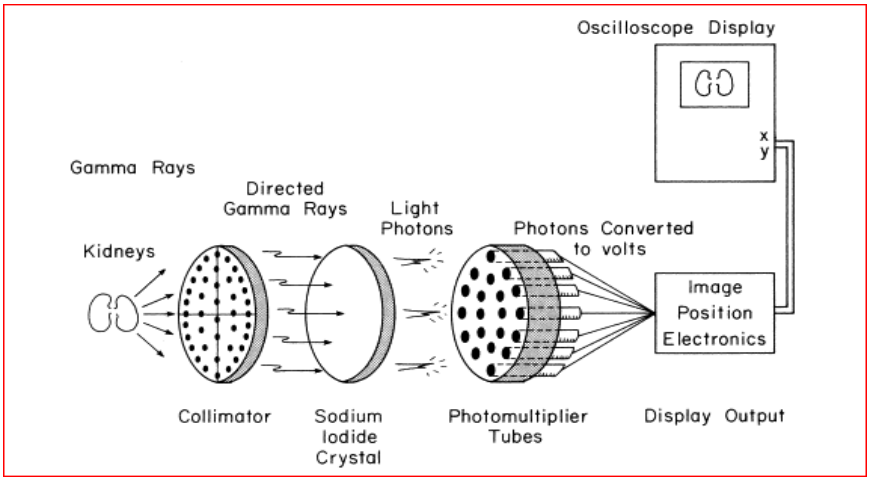

Figure (1-3): The most important parts of the camera device.

7. Positron Emission Imaging (PET)

Positron imaging (PET) is particularly used to screen for brain and heart diseases. As in nuclear medicine, an isotope with a short half-life is used, so the duration of its radioactivity in the body is short, such as the fluorine isotope 18F, which can be used in the synthesis of substances consumed in the human body, such as glucose, which is consumed directly by cancer cells.

8. Photoacoustic imaging

Acoustic imaging technology has recently been developed and used in medical imaging applications. It combines the features of optical absorption with field ultrasound to obtain images at relatively large depths. Recent research has shown that acoustic imaging technology can be used in analyzing and monitoring tumors, blood oxidation, functional brain imaging, and detecting skin tumors.

9. X-Ray Films

It is an imaging test to photograph different areas of the body, and it is the least risky radiographic test in terms of exposure to radiation. This type of medical imaging is considered the best for imaging bones, especially long bones and calcified parts, as well as air wherever it is found in the body. During this technique,

10. D printing in the health sector

3D printing is starting to make its way into the healthcare sector around the world. 3D printing is a type of robot that can create anything in 3D, regardless of its shape, by placing layers of raw material under the control of a computer. Experts in this field talk about the existence of many special techniques and methods within 3D printing technology tools that would meet the region’s health care needs, as this technology is currently being used primarily to assist in surgical operations. These models can be created by capturing 3D data so that surgical teams can create a magnified visual image of a particular area they are focusing on thus enabling them to plan all the details of the surgery with extreme precision even before the patient sets foot in the operating room.

11. Robots in surgical operations

The use of robots in the medical field has increased significantly in recent years, and the demand for it is still increasing, as the size of this market is expected to reach $20 billion in the year 2023. The robot is used in medicine and surgical operations, where the surgeon directs the robot via a computer console. From commands to move the robot's arms, and programmed for the steps of the process. It is also used in more precise surgeries, relieving pain, creating only a small wound, and minimizing blood loss. The demand for it has increased in the field of laparoscopic surgery, specifically neurological, orthopedic and endoscopic surgery, and it has also been used in colon and rectal

surgery, cancer surgery, throat operations, prostate, liposuction and obesity surgery, open-heart operations, catheterization and arteries.

One of the most common types of robots is those that are used to assist the surgeon, who controls them remotely and helps him during surgical operations, especially in less invasive procedures. Robotic arms are considered the basis of these robots through the great development in their working mechanism, so that they can be controlled from outside the operating room, and they help Also surgeons perform complex operations. This type of robot has contributed to increasing the ability of surgeons to perform surgical operations that are difficult for humans to perform, as the surgeon moves the robot's hands and directs them using the computer, and through the surgeon's commands, the computer analyzes and translates them, and then executes them on the patient's body using the robot's arms. There are also rehabilitation robots that play an important role in helping people in recovery homes, especially those who suffer from certain disabilities, as they help increase their motor ability, strength, performance, and quality of life as a result of their ability to be programmed to suit the condition of each individual patient, which increases the chance of patients overcoming the condition. Trauma that they may have been exposed to in an accident or stroke, and neurological disorders, whether behavioral or muscular, such as multiple sclerosis.[6,7[

Positron emission tomography (PET) technology

Positron Emission Tomography (PET)

Positron Emission Tomography is a technology used in nuclear medicine and is symbolized by the symbol (PET), short for Positron Emission Tomography, which shows three-dimensional images of some organs of the body and what may be cancerous tumors or cancerous metastases in them. It is also possible through it to inspect various functional processes in the body. Such as the vital processes of the digestive system. The imaging device works on the basis of detecting pairs of gamma rays emanating indirectly from a radioactive isotope that is a source of positrons (positively charged electrons). The radioactive material is injected into the patient's body after attaching it to an active biological molecule (such as a sugar molecule). The radioactive material is concentrated in the organ to be examined, such as the brain, kidneys, or liver. Then the measurements of the gamma rays emanating from the organ are recorded and three-dimensional images of them are constructed by the computer, which can be viewed on a screen connected to the computer. If the biologically active part that binds to the qaffa is the FDG molecule, imaging the concentration of the qaffa gives a measurement of the size and shape of the tumor in the affected organ or shows the course of metabolic activity. Although the use of this method has become common in positron emission tomography. As for computed tomography technology, it is a device that uses x-rays with computer technology to take pictures of the human body that can be exploited in the field of medicine. ,8] [6,7

Positron

A positron is an elementary particle that is not part of ordinary matter, and it is considered the anti-electron particle. It is identical to the electron in all physical characteristics and characteristics, except for the electric charge. The positron carries a positive electrical charge, unlike the electron, which carries a negative electrical charge. If they collide, what is known as electron-positron annihilation occurs. It is a particle whose rest mass is equivalent to the electron's rest mass, m, and its electric charge is equivalent to the charge of the electron - e - in absolute value, but it differs from it in that it is positive. For a positron, spin is equal to the electron's spin (ħ/2), where ħ represents Planck's constant divided by 2.

Gamma rays used in the PET device

Gamma rays are electromagnetic rays that were discovered in 1900 by the French scientist Villard. It is a product of nuclear reactions that often occur in space, and it is also produced from radioactive elements such as uranium and other radioactive substances. It spreads in vacuum and air, at a speed equal to the speed of light, and has higher energy and greater ability to penetrate than ultraviolet rays and X-rays. Its waves are very short, and their lengths range from 0.05 angstroms to 0.005 angstroms. Gamma rays have a very harmful effect on living cells, and were it not for the presence of the atmosphere around the Earth that absorbs and scatters these high-frequency, high-energy rays, life on the surface of the Earth would have ceased to exist.

Because gamma rays have a superior ability to penetrate and penetrate objects. Its ability to destroy living cells is due

to the fact that it is ionizing radiation, meaning that it causes ionization in matter, and ionization of living matter means damage that may lead to cell death.[3,7] As for its uses, it is used in the medical and industrial fields, but in very small quantities, as the doses of radiation given to the patient are calculated with great precision so that they destroy cancer cells, and as for healthy body cells, they regain their health after a period of recovery and are able to follow the progress of vital processes in the body And in treatment. In medicine, it is often used to kill cancer cells. In the industrial field, it is used to photograph petroleum pipes to determine the quality of the pipes and the safety of the welds, in addition to killing germs in canned food and sterilizing grains. Since it is a product of nuclear reactions, it is undoubtedly used in reactors and nuclear bombs.

The purpose of the PET device

Positron emission tomography (PET) is an effective way to examine chemical activity in parts of the body. It may help identify a variety of conditions, including many types of cancer, heart disease, and brain disorders. Images from a positron emission tomography (PET) scan provide different information than other types of scans, such as computed tomography (CT) or magnetic resonance imaging (MRI). Using a positron emission tomography scan, or a combined CT scan, your doctor can diagnose the disease and better evaluate your condition.

PET scans must be interpreted carefully because noncancerous conditions can resemble cancerous conditions, and some cancer cells do not show up on PET scans. There are many types of solid tumors that appear in positron emission tomography scans, including: (brain, cervix, colon and rectum, esophagus, head and neck, lung, lymphoma, melanoma, pancreas, prostate, and thyroid).[8, 7]

Heart disease:

Positron emission tomography (PET) scans can detect areas of reduced blood flow in the heart. This information can help you and your doctor determine, for example, whether you might benefit from a procedure to open blocked heart arteries (angioplasty) or coronary artery bypass surgery.

Brain disorders:

PET scans can be used to evaluate some brain disorders, such as tumors, Alzheimer's disease and epileptic seizures.

Steps to be taken to prepare for the PET examination

Before starting the photography process, there are several procedures that must be taken:

- The patient may be asked to wear a special coat before entering the PET examination procedure, and he may be allowed to enter the examination in his normal clothes.
- The patient must inform the doctor of any medications he is taking, even if they are vitamins, natural herbs, or nutritional supplements. Also if he has an allergy of any kind. He must inform the doctor of any recent illness he has suffered and inform him of the details of his health condition.
- Get rid of jewelry and accessories before the examination, as they may affect the results of the examination.
- The patient is usually given specific instructions depending on the type of examination he will undergo, and diabetics have special instructions that must be prepared before the examination.

PET scanning process

In examinations performed using X-rays, the image is obtained by passing X-rays from a source outside the human body. As for imaging using nuclear medicine, the examination begins by giving the patient a specific dose of the radioactive material, which is directed to the organ in the human body to be examined. The radioactive materials emit gamma rays. The gamma camera captures these rays and turns them into an electrical signal that the computer receives, analyzes and forms the image.[6,8[

Stages of image formation in PET

After listening to the patient's medical history and the radiographs that were previously performed on him and evaluating them, the patient is transferred to the patient preparation room. After examining and evaluating the value of diabetes in the patient's blood while he is fasting, skilled and practicing nurses open the path of the blood vessel to

glaucoma and inject the short-lived radioactive substance (radioactive isotope) or what is called "imaging material." This imaging material is often a glucose substance.) Glucose fluoride 18F-FDG, which is a radioactive substance that has previously undergone several tests and analyzes for quality in terms of not having side effects such as allergies.

It takes 30-60 minutes for this substance to spread into the blood circulation, which is a period during which the patient waits while lying in bed in a state of rest. If the goal is to image the brain, the patient must rest before injecting the radioactive dose for 20-30 minutes without speaking, reading, or listening to anything in a semi-dark room in order to rest the brain by closing all the brain's sensors and alerts.[8[

After completing the rest and waiting period, the patient is transferred to the imaging and scanning room, and after the patient lies on the bed of the device in the appropriate position for imaging with the help of nurses or professionals, the imaging and scanning begins, which takes about 20 - 25 minutes, and after the imaging begins, the patient's bed is slowly moved to pass. The body part of collecting images is in the shape of a ring, and in this way the patient remains in an open place and not closed. The PET/CT device is very suitable for patients who are afraid of enclosed spaces. During the imaging period, the patient is expected to be still, breathing normally and without movement while lying on the bed of the device to ensure the quality of the images. In the event of movement, it may make it difficult to evaluate the images, and we may have to repeat the imaging again, which prolongs the duration of the imaging. After completing the imaging process, an initial technical evaluation of what was photographed and scanned with the device is carried out. In the event that additional scanning and imaging are not requested, the patient can leave the center whenever he wishes. The patient can eat and drink as he pleases after completing the imaging process. The total time period for examination using the PET/CT device takes approximately 2-3 hours, which includes patient preparation and imaging procedures.[9[

How is the image printed in PET?

Your doctor will receive it within 48 hours, along with a report detailing normal and abnormal findings. The image will highlight "hot spots" where excessive amounts of radioactive isotopes have accumulated. These are areas of high cellular metabolism. While this may be synonymous with cancer, the spots are difficult to decipher, and other explanations may exist. Your doctor may order multiple tests to reach a final diagnosis. In contrast, areas with less radiation accumulation are known as "cold spots." This indicates areas of low metabolic activity, often as a result of decreased blood flow or tissue necrosis (tissue death.(

Benefits, risks and disadvantages of PET technology

First: Benefits:

1. The information that the doctor obtains from nuclear medicine examinations is unique and often not possible Obtained by other techniques.
2. For many diseases, nuclear medicine diagnosis provides the best information needed

The doctor will determine the appropriate treatment .

3.The patient treated with nuclear medicine does not feel pain compared to alternative surgical operations.

4.By identifying changes in the body at the cell level, PET images reveal

The disease is in its early stages before any other examination such as CT or MRI detects it.

Second: Risks

- The dose of radioactive materials injected into the patient is relatively small and does not expose him to any significant risk

Compared to the benefits he gets.

- Nuclear medicine has been used for more than 50 years, and therefore it has been verified that there are no side effects

Long-term damage due to the small dose of radioactive materials he ingested.

- It is possible that there is a kind of sensitivity in the body of some people to radioactive materials, but

These are considered very rare cases.

- Injecting the body with radioactive materials may cause temporary pain.
- A pregnant or breastfeeding woman must inform the doctor of this before he makes his decision to perform the procedure

Third: Disadvantages of PET scan

- The large number of preparations related to nuclear medicine consume a lot of time, because the arrival of the radioactive material to the part to be examined and photographed may sometimes take hours and other times it is necessary to wait for days.
- The analytical capacity of images taken with nuclear medicine techniques is less than other techniques such as CT and MRI. But the information we get from nuclear medicine cannot be accessed by any other diagnostic technique.
- PET scanning can lead to misleading results if the chemical balance in the body is abnormal, meaning that the test results of a PET scan for a person with diabetes or for a person who ate a meal a few hours before the examination, the results will be greatly affected by the change in blood sugar level. Or the level of insulin in the blood[6,8,9] .

The difference between MRI, PET, and CT

The PET device gives information about cells and their functions by distinguishing between cells and tissues that are metabolically active in the body, and this is something that is not available in the images produced by a computed tomography (CT) or magnetic resonance imaging (MRI) device. CT uses X-rays, MRI uses magnetic fields, and positron emission tomography uses radioactive materials such as oxygen-15. In addition, PET does not produce detailed images of organ structures as do CT or MRI

The difference between gamma rays and X-rays

X-rays are lower in energy and frequency than gamma rays. For this reason, the energy of The energy of gamma rays is greater than the energy of Computed tomography (CT) machine

Computed tomography (CT) device

Computed tomography (CT), formerly referred to as axial tomography (CAT), is a common diagnostic imaging procedure that uses X-rays to generate pictures (slices) of anatomy.

Purpose of the device

Computed tomography (CT) is an x-ray imaging procedure used for a variety of clinical applications. Computed tomography is used for imaging the spine and head, gastrointestinal imaging, vascular imaging (such as detecting blood clots), staging cancer and radiation therapy, screening for cancers and heart disease, rapid imaging of trauma, imaging of musculoskeletal disorders, detecting signs of infectious diseases, and guiding some Interventional procedures (eg biopsies). CT is the imaging test of choice for diagnosing several types of cancers. Along with chest X-ray, CT is the most common procedure for imaging the chest. CT is also used to perform non-invasive angiography to evaluate large blood vessels.[10]

CT scanning can be performed on newborns, infants, children, and adolescents. In children, CT scanning is frequently used in a hospital emergency department to evaluate the effects of trauma, especially to the head, face, brain, and spine, and to diagnose or rule out appendicitis and other abdominal disorders because the scan can be completed in less than 20 seconds. Chest CT scans are used to evaluate complications caused by infectious diseases, such as pneumonia, tuberculosis, airway inflammation, and birth defects. CT scan of the pelvis is used to image ovarian cysts and tumors, bladder abnormalities, urinary tract stones, kidney disease, and bone disease.[11]

Principal of CT Scan

A CT scan is performed using a specialized scanner, an X-ray system, a patient table, and a computer workstation. The CT scanner is shaped like a large square with a hole in the center or circular like a donut. X-rays are produced in the form of a beam that rotates around the patient. During a CT scan, the patient's table is moved through the central hole as the X-ray rays pass through the patient's body. The x-rays are converted into a series of black-and-white images, each representing a "slice" of the anatomy.

A CT scan is performed by a technologist with specialized training in X-rays and CT imaging. During the scan, the technician operates the CT scanner using a computer located in an adjacent room. Because movement during the examination can cause inaccurate images, the technologist instructs the patient via an intercom to hold their breath and not move during the x-ray. The examination itself may only take five to 15 minutes, but the total examination time may take up to 30 minutes, as the patient must be prepared and positioned.[8,10]

Images taken from a CT scan are called slices because they are acquired in very small (millimeter-sized) parts of the body. Image slides are displayed on a computer screen for viewing or printed as a movie. A radiologist interprets the X-ray images produced during a CT scan. For emergency CT scans, the images are interpreted immediately so that the child can be treated as soon as possible.

In emergency situations, a CT scan is performed in the radiology department of the hospital in combination with a false-color CT scan through the abdomen, showing the liver (larger yellow organ) and spleen (smaller yellow organ). The abdominal aorta is colored red and is located above the spine and between the kidneys.

False-color CT scan of the abdomen, showing the liver (larger yellow organ) and spleen (smaller yellow organ). The abdominal aorta is colored red and is located above the spine and between the kidneys.[12]

Components of the computed tomography (CT) device.

Most of the components of the CT scan machine are located inside the CT scanner. In addition, the CT scan machine also consists of an examination table and a control room. The design of CT scan rooms is usually similar, with the examination table and CT scanner being in a room, while the control room is outside behind a lead barrier to protect against radiation.[9,10]

In the control room there is a special computer that the radiology technician works on at the time of imaging, and part of the wall must be a window made of lead-equivalent glass so that we can see inside the room to intervene in the event of any emergency. The entrance for patients is different from the entrance for radiology technicians for several reasons, the most important of which are: protection from infection and so that it cannot be opened from the outside to ensure that no one enters at the time of radiation. It must also be a wide entrance to suit the patients' beds.

CT scanner

A CT scanner consists of the following parts:

High Voltage Generator 1- Equipped with high voltages

Modern high-voltage devices are so small that they can be placed inside a CT scanner. Their function is to produce high voltages and send them to the X-ray tube.

X-ray tube

The function of the x-ray tube is to generate x-rays. The x-ray tube acts as a specific transducer, receiving electrical energy and converting it into two other forms of energy: x-rays and heat. Heat is the undesirable product of this conversion process; So X-rays are created by taking energy from electrons and electrons

How to prepare the patient for the CT scan

A regular CT scan does not require any special preparations. However, if the examination requires taking a contrast material, there will be a need to fast for several hours before the examination is performed. Usually for a period ranging between 6-8 hours of fasting.

As the examination approaches, all metal objects must be removed from the body. The contrast material is then administered in one of two ways: Orally - where the patient drinks 4-6 cups, each with a capacity of half a liter,

gradually over a period of one to two and a half hours before the examination. Or by injecting iodine intravenously, by injection, which may cause some pain.[17, 12]

Conduct a CT examination

In order to perform a CT scan, the patient is required to lie down on the bed of the scanning machine. This device is a large, square-shaped device with a vacuum in its center. The bed moves during the imaging process, in and out of the device. Also, the patient is asked not to move during the examination, and the imaging technician gives the patient some specific instructions on how to behave during the examination. People accompanying patients are also prevented from entering the corridor and examination room, due to the large amount of harmful rays that are emitted from the device.

The examination itself does not cause any pain, and lasts for a period ranging from 15 to 30 minutes. after examination:

In general, there is no need to take special measures after the examination. The only risks associated with this type of examination may be due to short-term exposure to radiation and/or allergic reactions to contrast materials (mostly due to sensitivity to iodine).[17]

Features and benefits of computed tomography

- CT is a test that is performed much faster than MRI, and has become the study of choice in cases of trauma or other acute neurological emergencies.
- The cost of CT scan is much lower than MRI.
- Computed tomography is less sensitive to the patient's movement during the examination, as the image can be obtained more quickly.
- CT can be easy to perform in patients with claustrophobia.[15,16]

Are there risks when using a CT scan?

During a CT scan, the patient is exposed to doses of ionizing radiation, higher doses than those to which the patient is exposed during X-ray imaging, of course. It has not been proven that these doses of radiation may lead to long-term damage, but in some cases the patient may be exposed to very high doses of radiation that could increase the chances of developing cancerous tumors in the future, and therefore doctors try to use the lowest possible doses of radiation during CT scans. . The rays used in CT scans harm cells in the body and nuclear acid, which causes various cancers, and CT scans used in diagnosing cancerous tumors may cause cancer. The amount of radiation produced by these devices is more than a thousand times greater than the amount produced by X-rays. Although CT scanning has side effects, it cannot be dispensed with and replaced by other imaging methods. [17]

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