Basics of CT Scan

Body CT / CAT scan

- Body CT scans can take images of any body part that can fit in the CT scanner.
- Modern CT scanners can take images of a patient's entire body in well under a minute.
- This can be useful when doctors need to see many different body parts and organs quickly, for instance after a motor vehicle accident.

CT (CAT) scanning

—is a noninvasive medical test that helps physicians diagnose and treat medical conditions.

- combines special x-ray equipment with sophisticated computers to produce multiple images or pictures of the inside of the body.

- These cross-sectional images of the area being studied can then be examined on a computer monitor, printed or transferred to a CD.

What a Body CT can see …

Body CT scans can diagnose a variety of conditions such as:

- Broken bones (skull, spine, ribs, extremities)
- Blood clots in the brain and chest
- Abnormalities of the lungs, such as pneumonia
- Inflammation in the abdomen (such as appendicitis or gallbladder disease)
- Stones (in the gallbladder or kidneys)
- Blocked bowel passage or twisted bowel
- Cancers in various organs and body parts

Some common uses of the procedure

- one of the best and fastest tools for examining the chest, abdomen and pelvis
- it provides detailed, cross-sectional views of all types of tissue.
- used to examine patients with severe injuries from incidents such as a motor vehicle accident.
- performed on patients with acute symptoms such as abdominal pain or difficulty breathing.

- often the best method for detecting many different cancers, including lung, liver, kidney and pancreatic cancer, since the image allows a physician to confirm the presence of a tumor and measure its size, precise location and the extent of the tumor's involvement with other nearby tissue.
- an examination that plays a significant role in the detection, diagnosis and treatment of vascular diseases that can lead to stroke, kidney failure or even death.
- CT is commonly used to assess for pulmonary embolism (a blood clot in the lung vessels) as well as for abdominal aortic aneurysms (AAA).
- invaluable in diagnosing and treating spinal problems and injuries to the hands, feet and other skeletal structures because it can clearly show even very small bones as well as surrounding tissues such as muscle and blood vessels.

For children

CT imaging is more often used to evaluate:

- lymphoma
- neuroblastoma
- kidney tumors
- congenital malformations of the heart, kidneys and blood vessels
- cystic fibrosis
- complications of acute appendicitis
- complications of pneumonia
- inflammatory bowel disease
- severe injuries

Physicians often use the CT examination to:

- quickly identify injuries to the lungs, heart and vessels, liver, spleen, kidneys, bowel or other internal organs in cases of trauma.
- guide biopsies and other procedures such as abscess drainages and minimally invasive tumor treatments.
- plan for and assess the results of surgery, such as organ transplants or gastric bypass.
- stage, plan and properly administer radiation treatments for tumors as well as monitor response to chemotherapy.
- measure bone mineral density for the detection of osteoporosis.

How does a CT scanner work?

- CAT scan = Computer Aided Tomography scan
- A CAT scanner is a machine that combines xray equipment with advanced computers.
- The x-ray equipment spins around in a circle inside the machine.
- The patient is put on a table that moves the patient slowly through the opening in the scanner while images are taken at the same time.

Here is what a CT scanner looks like

Equipment

- The CT scanner is typically a large, box-like machine with a hole, or short tunnel, in the center.
- The Patient will lie on a narrow examination table that slides into and out of this tunnel.
- Rotating around patient, the x-ray tube and electronic x-ray detectors are located opposite each other in a ring, called a gantry.
- The computer workstation that processes the imaging information is located in a separate control room, where the technologist operates the scanner and monitors your examination.

What happens before a CT scan?

- First, your radiologist looks at all available information about you.
  - This may include your medical history, physical examination findings and laboratory results.
- The radiologist then prescribes exactly how the CT scan will be performed.

What happens before a CT scan?

- Sometimes contrast material or "dye" needs to be given to highlight blood vessels and diseases in organs.
- If contrast material ("dye") is needed for the exam, you may be asked to have your kidney function checked.
- A simple blood test can determine whether the kidneys are working fine.

Body CT / CAT Scan: before and during the test

- You may be asked to be on clear liquids only for several hours before the scan.
- Oral contrast makes it easier to see your bowel loops.
- A small catheter may be used so that contrast material ("dye") can be given to you during the exam.
- You may be asked to hold your breath during the scan.

How does the procedure work?

- In many ways CT scanning works very much like other x-ray examinations.
- X-rays are a form of radiation—like light or radio waves—that can be directed at the body. Different body parts absorb the x-rays in varying degrees.
- In a conventional x-ray exam, a small amount of radiation is aimed at and passes through the body, recording an image on photographic film or a special image recording plate.
- Bones appear white on the x-ray; soft tissue, such as organs like the heart or liver, shows up in shades of gray and air appears black.

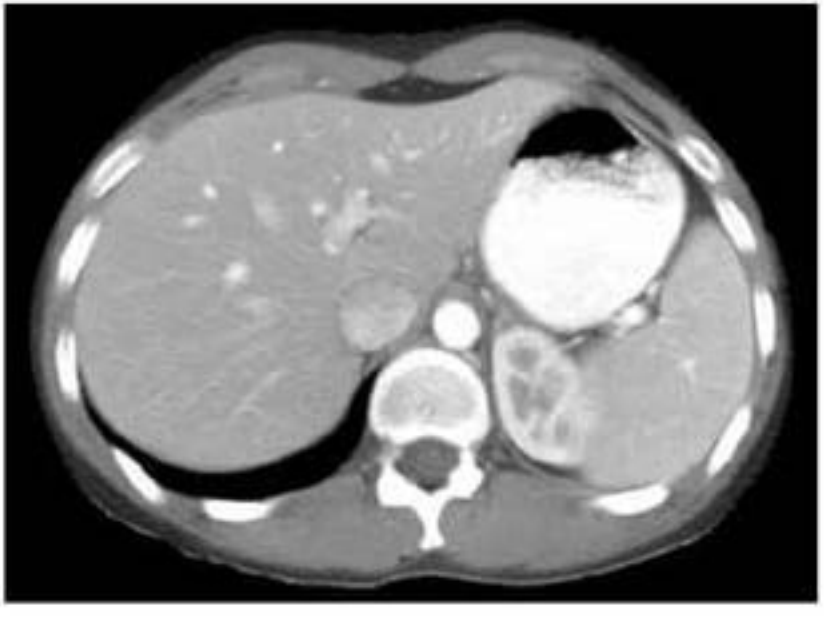
- With CT scanning, numerous x-ray beams and a set of electronic x-ray detectors rotate around patient, measuring the amount of radiation being absorbed throughout your body.

- At the same time, the examination table is moving through the scanner, so that the x-ray beam follows a spiral path.

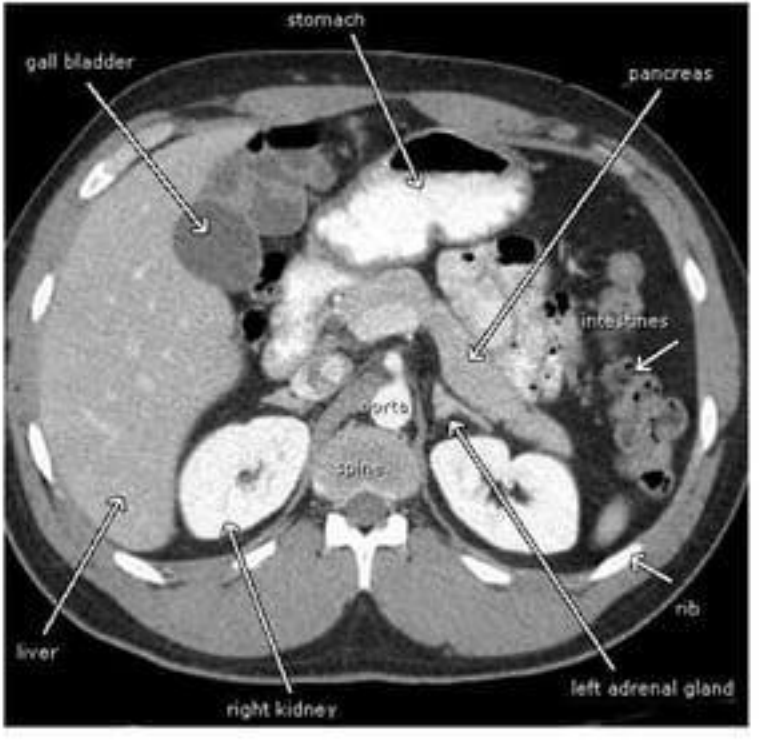
- A special computer program processes this large volume of data to create two-dimensional cross-sectional images of your body, which are then displayed on a monitor.

- This technique is called helical or spiral CT.

CT scan showing the liver



CT slice through the mid-abdomen showing multiple normal-appearing organs



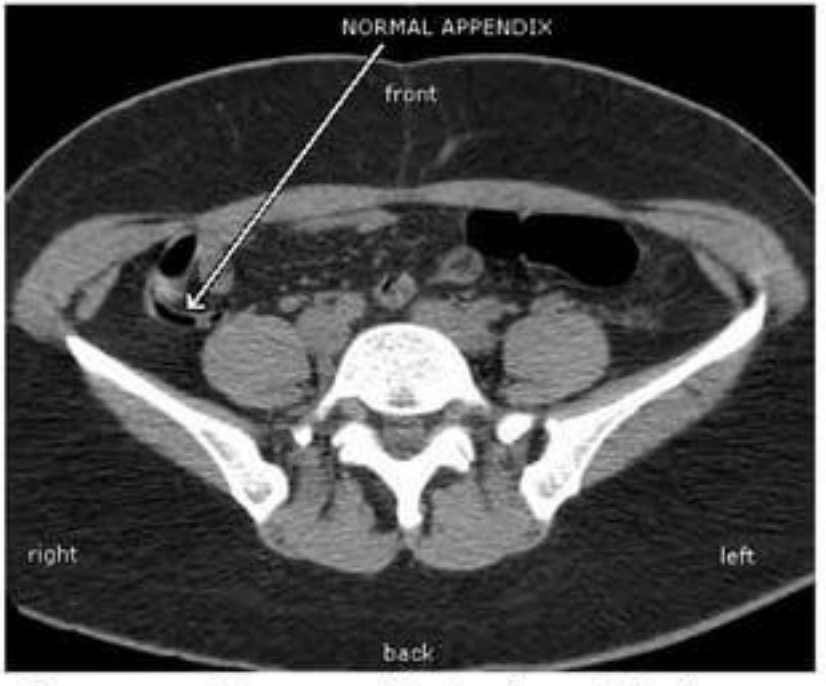
- CT imaging is sometimes compared to looking into a loaf of bread by cutting the loaf into thin slices.
- When the image slices are reassembled by computer software, the result is a very detailed multidimensional view of the body's interior.
- Refinements in detector technology allow new CT scanners to obtain multiple slices in a single rotation.
- These scanners, called multislice CT or multidetector CT, allow thinner slices to be obtained in a shorter period of time, resulting in more detail and additional view capabilities.

How is the CAT scan performed?

- The technologist begins by positioning patient on the CT examination table, usually lying flat on back or less commonly, on one side or on stomach.
- Straps and pillows may be used to help you maintain the correct position and to hold still during the exam.
- Depending on the part of the body being scanned, patient may be asked to keep hands over head.

- If contrast material is used, it will be swallowed, injected through an intravenous line (IV) or administered by enema, depending on the type of examination.
- Next, the table will move quickly through the scanner to determine the correct starting position for the scans.
- Then, the table will move slowly through the machine as the actual CT scanning is performed.
- Depending on the type of CT scan, the machine may make several passes.
- Patient may be asked to hold breath during the scanning.

- Any motion, whether breathing or body movements, can lead to artifacts on the images.
- This is similar to the blurring seen on a photograph taken of a moving object.
- When the examination is completed, you will be asked to wait until the technologist verifies that the images are of high enough quality for accurate interpretation.
- The CT examination is usually completed within 30 minutes. The portion requiring intravenous contrast injection usually lasts only 10 to 30 seconds.



- CT scan of a normal appendix in the right lower abdomen.
- The appendix normally connects with the right colon and contains air (this appears black on the scan).
- Air in the appendix excludes appendicitis since this means that the appendix is not obstructed or inflamed.

- Appendicitis: The appendix (A) is distended and inflamed.
- In this patient the appendix has not yet ruptured

Body CT – 3D images

- 3-D images look like the "real thing."
- They can show details, such as broken bones.
- They are helpful in guiding surgeons before complex operations.

Interpretation of a CT scan

Radiologist reading CT on a computer monitor

- Most radiologists look at CT images on computer monitors.
- It takes a lot of training and experience to interpret CT scans.
- A board certified radiologist is a physician qualified to independently prescribe, supervise and interpret a CT exam.

Benefits vs. Risks

Benefits:

- CT scanning is painless, noninvasive and accurate.
- A major advantage of CT is its ability to image bone, soft tissue and blood vessels all at the same time.
- Unlike conventional x-rays, CT scanning provides very detailed images of many types of tissue as well as the lungs, bones, and blood vessels.
- CT examinations are fast and simple; in emergency cases, they can reveal internal injuries and bleeding quickly enough to help save lives.
- CT has been shown to be a cost-effective imaging tool for a wide range of clinical problems.
- CT is less sensitive to patient movement than MRI.

Benefits:

- CT can be performed if you have an implanted medical device of any kind, unlike MRI.
- CT imaging provides real-time imaging, making it a good tool for guiding minimally invasive procedures such as needle biopsies and needle aspirations of many areas of the body, particularly the lungs, abdomen, pelvis and bones.
- A diagnosis determined by CT scanning may eliminate the need for exploratory surgery and surgical biopsy.
- No radiation remains in a patient's body after a CT examination.
- X-rays used in CT scans usually have no immediate side effects.

Risks

- There is no conclusive evidence that radiation at amounts delivered by a CT scan causes cancer.
- Large population studies have shown a slight increase in cancer from larger amounts of radiation, such as from radiation therapy.
- Thus, there is always concern that this risk may also apply to the lower amounts of radiation delivered by a CT exam.

Risks

- The effective radiation dose for this procedure varies.
- CT scanning is, in general, not recommended for pregnant women unless medically necessary because of potential risk to the baby.
- Manufacturers of intravenous contrast indicate mothers should not breastfeed their babies for 24-48 hours after contrast medium is given.
- The risk of serious allergic reaction to contrast materials that contain iodine is extremely rare, and radiology departments are well-equipped to deal with them.

Limitations of CT Scanning of the Body

- Soft-tissue details in areas such as the brain, internal pelvic organs, and joints (such as knees and shoulders) can often be better evaluated with magnetic resonance imaging (MRI).
- In pregnant women, while CT can be performed safely, other imaging exams not involving radiation, such as ultrasound or MRI, is preferred if they are likely to be as good as CT in diagnosing your condition.
- A person who is very large may not fit into the opening of a conventional CT scanner or may be over the weight limit—usually 450 pounds—for the moving table.