

## Computed Tomography (CT)-Abdomen

*This procedure is reviewed by a physician with expertise in the area presented and is further reviewed by committees from the American College of Radiology (ACR) and the Radiological Society of North America (RSNA), comprising physicians with expertise in several radiologic areas.*

### What is CT Scanning of the Abdomen?

Computed tomography (CT)—sometimes called CAT scan—uses special x-ray equipment to obtain image data from different angles around the body then uses computer processing of the information to show a cross-section of body tissues and organs.

CT imaging is particularly useful because it can show several types of tissue with great clarity, including organs like the liver, spleen, pancreas and kidneys. Using specialized equipment and expertise to create and interpret CT scans of the lower gastrointestinal (GI) tract, the colon and the rectum, an experienced radiologist can accurately diagnose many causes of abdominal pain such as an abscess in the abdomen, an inflamed colon or colon cancer, diverticulitis and appendicitis. Often, no additional diagnostic workup is necessary and treatment planning can begin immediately.

### What are some common uses of the procedure?

Because it is a non-invasive procedure that provides detailed, cross-sectional views of all types of tissue, CT is becoming the preferred method for diagnosing many diseases of the bowel and colon, including diverticulitis and appendicitis, and for visualizing the liver, spleen, pancreas and kidneys. In cases of acute abdominal distress CT can quickly identify the source of pain. When pain is caused by infection and inflammation, the speed, ease and accuracy of a CT examination can reduce the risk of serious complications caused by a burst appendix or ruptured diverticulum and the subsequent spread of infection. In cases where bowel obstruction is suspected, CT may be the best imaging test.

CT is often the preferred method for diagnosing many different cancers, including colon cancer, since the image allows a physician to confirm the presence of a tumor and to measure its size, precise location and the extent of the tumor's involvement with nearby tissue. CT examinations of the lower GI tract can be used to plan and properly administer radiation treatments for tumors and to guide biopsies and other minimally invasive procedures. Many dedicated shock-trauma centers have a CT scanner in the trauma department. CT can also play a significant role in the detection, diagnosis and treatment of vascular disorders that can lead to stroke, gangrene or kidney failure.

### How should I prepare for the CAT scan?

You should wear comfortable, loose-fitting clothing for your CT exam. Metal objects can affect the image, so avoid clothing with zippers and snaps. You may be asked to remove hairpins, jewelry, eyeglasses, hearing aids and any removable dental work that could obscure the images. You also may be asked to refrain from eating or drinking anything for an hour or longer before the exam. Women should always inform their doctor or x-ray technologist if there is any possibility that they are pregnant.

### What does the equipment look like?

The CT scanner is a large, square machine with a hole in the center, something like a doughnut. The patient lies still on a table that can move up or down and slide into and out from the center of the hole. Within the machine an x-ray tube on a rotating gantry moves around the patient's body to produce the images, making clicking and whirring noises as the arm moves. Though the

technologist will be able to see and speak to you, you will be alone in the room during the exam.

An example of the CT equipment that may be used follows.



## How does the procedure work?

In many ways CT scanning works very much like other x-ray examinations. Very small, controlled amounts of x-ray radiation are passed through the body while different tissues absorb the radiation at different rates. With plain radiology, an image of the inside of the body is captured when special film is exposed to the absorbed x-rays. With CT, the film is replaced by an array of detectors that measure the x-ray profile.

Inside the CT scanner is a rotating gantry that has an x-ray tube mounted on one side and an arc-shaped detector mounted on the opposite side. During each full rotation, as the fan-shaped x-ray beam is emitted through the patient's body, an image of a thin section is acquired. The detector records about 1,000 images—or profiles—of the expanded x-ray beam with each rotation. The profiles are then reconstructed by a dedicated computer into two-dimensional images of the sections that were scanned. Multiple computers are typically used to control the entire CT system.

You might think of it as looking into a loaf of bread by cutting the bread into thin slices. When the image slices are reassembled by computer the result is a very detailed, multidimensional view of the body's interior.

With spiral—or helical—CT, refinements in detector technology support faster, higher-quality image acquisition with less radiation exposure. The current spiral CT scans are called multidetector CT and are most commonly four- or 16-slice systems. CT scanners with 64 detectors are now available. These instruments should provide either faster scanning or higher resolution images. Using 16-slice scanner systems the radiologist

can acquire 32 image slices per second. A spiral scan can usually be obtained during a single breath hold. This allows scanning of the chest or abdomen in 10 seconds or less. Such speed is beneficial in all patients but especially in populations in which the length of scanning was often problematic, such as elderly, pediatric or critically-ill patients. The multidetector CT also allows applications like CT angiography to be more successful.

With conventional CT, small lesions may frequently go undetected when a patient breathes differently on consecutive scans, as a lesion may be missed by unequal spacing between scans. The speed of spiral scanning and a single breath hold increase the rate of lesion detection.

## How is the CAT scan performed?

The technologist begins by positioning the patient on the CT table. The patient's body may be supported by pillows to help hold it still and in the proper position during the scan. As the study proceeds the table will move slowly into the CT scanner. Depending on the area of the body being examined, the increments of movement may be so small that they are almost undetectable or large enough that the patient feels the sensation of motion.

A CT examination of the gastrointestinal tract requires the use of a contrast material (this may be barium, iodine or in some cases water) to enhance the visibility of certain tissues. The contrast material may be swallowed or administered by enema. Before administering the contrast material the radiologist or technologist may ask whether the patient has any allergies, especially to medications or iodine, and whether the patient has a history of diabetes, asthma, a heart condition, kidney problems or thyroid conditions. These conditions may indicate a higher risk of reaction to the contrast material or potential problems eliminating the material from the patient's system after the exam.

A CT examination usually takes five minutes to half an hour. When the exam is over, the patient may be asked to wait until the images are examined to determine if more images are needed.

## What will I experience during the procedure?

CT scanning causes no pain, and with spiral CT the need to lie still for any length of time is reduced. For examinations of the abdomen and lower gastrointestinal tract you may be asked to swallow either water or a positive contrast material, a liquid that allows the radiologist to better see the stomach, small bowel and

colon. Some patients find the taste of the contrast material mildly unpleasant, but most can easily tolerate it. Your exam may require the administration of the material by enema if the colon is the focus of the study. Many patients also receive iodine intravenously (injected into a vein) to help evaluate blood vessels and organs such as the liver, kidneys and pancreas.

You will be alone in the room during the scan; however, the technologist can see, hear and speak with you at all times. With pediatric patients, a parent may be allowed in the room to alleviate fear but will be required to wear a lead apron to prevent radiation exposure.

## Who interprets the results and how do I get them?

A radiologist, who is a physician experienced in CT and other radiologic examinations, will analyze the images and send a signed report with his or her interpretation to the patient's primary care physician. The physician's office will inform the patient on how to obtain their results. New technology also allows for distribution of diagnostic reports and referral images over the Internet at some facilities.

## What are the benefits vs. risks?

### Benefits

- Viewing a CT scan an experienced radiologist can diagnose many causes of abdominal pain with very high accuracy enabling faster treatment and often eliminating the need for additional, more invasive diagnostic procedures.
- Unlike other imaging methods, CT scanning offers detailed views of many types of tissue, including the lungs, bones, soft tissues and blood vessels.
- CT scanning is painless, noninvasive and accurate.
- CT examinations are fast and simple. For example, in emergency cases they can reveal internal injuries and bleeding quickly enough to help save lives.
- Diagnosis made with the assistance of CT can eliminate the need for invasive exploratory surgery and surgical biopsy.
- CT scanning can identify normal and abnormal structures, making it a useful tool to guide radiotherapy, needle biopsies and other minimally invasive procedures.
- CT has been shown to be a cost-effective imaging tool for a wide range of clinical problems.

### Risks

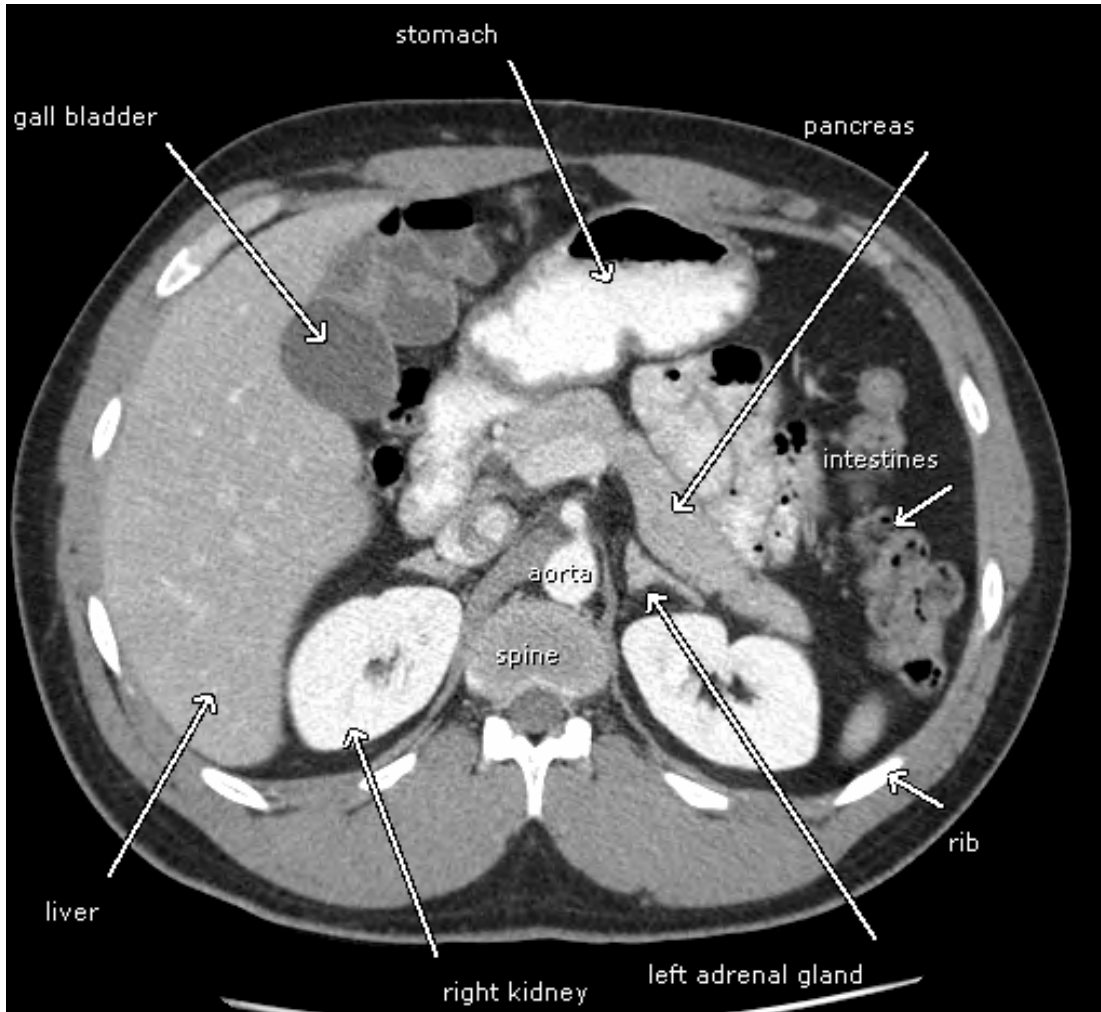
- CT does involve exposure to radiation in the form of x-ray, but the benefit of an accurate diagnosis far outweighs the risk. The effective radiation dose from this procedure is about 10 mSv, which is about the same as the average person receives from background radiation in three years. See the Safety page on the RadiologyInfo.org Web site for more information about radiation dose.
- Women should always inform their doctor or x-ray technologist if there is any possibility that they are pregnant.
- Nursing mothers should wait for 24 hours after contrast material (iodine) injection before resuming breast feeding.
- The risk of serious allergic reaction to iodine-containing contrast material is rare, and radiology departments are well-equipped to deal with them.

## What are the limitations of CT Scanning of the Abdomen?

The exam is not generally indicated for pregnant women.



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



CT slice through the mid-abdomen showing multiple normal-appearing organs, which are labeled.

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