

Pediatric CT (Computed Tomography)

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 Pediatric CT?

Computed tomography, also known as CT or CAT scan, is a type of x-ray imaging procedure which, like conventional x-ray imaging, is based on varying absorption of x-rays by different body tissues. In a CT exam, the beam of x-rays moves in a circle around the body, providing different views of the same organ or tissue in much greater detail than a conventional x-ray exam. A computer processes the imaging information and displays it on a monitor.

In children as well as adults CT scanning may be preferred to the customary x-ray exam. It may be performed in newborns and infants as well as older children and adolescents. CT scans may be done with or without contrast materials that are taken by mouth or injected into a vein. These contrast-enhanced exams often depict a particular organ, tissue or blood vessel more clearly.

What are some common uses of the procedure?

A CT scan may be recommended in order to detect a wide range of abnormalities or diseases in any part of your child's body. Among the more common reasons for requesting a CT scan are infectious or inflammatory disorders, abdominal pain, headaches and injury-related changes. CT also may be used to demonstrate birth defects, detect cancer and to periodically check to see if previously treated disease has recurred.

CT can evaluate the blood vessels serving the brain, face or neck. In children suffering head injuries the exam can display or rule out serious complications such as bleeding within the brain or other forms of brain damage. In addition, CT can display the spinal cord and the bones making up the spinal column.

Except for the chest x-ray, CT is the most commonly used imaging procedure for evaluating the chest. Some of the more common conditions that may be imaged by chest CT are:

- Complications from infections such as pneumonia.
- A tumor that arises in the lung or has spread there from a distant site.
- Airway disease such as inflammation of the bronchi (breathing passages).
- Birth defects.

CT can demonstrate injured blood vessels or lung damage in children. Using a newer type of CT called multidetector CT it is possible to obtain very detailed pictures of the heart and large blood vessels of the chest in children, even newborn infants.

CT is well-suited for visualizing diseases or injury of important organs in the abdomen including the liver, kidney and spleen. CT is sometimes used to diagnose appendicitis. CT has proved helpful for evaluating adolescents who have inflammatory disorders of the bowel such as colitis and for detecting abdominal tumors or birth defects.

CT scans of the pelvic region may help to find cysts or tumors of the ovary, abnormalities of the bladder, stones in the urinary tract and disease of the pelvic bones.

How should my child be prepared for the CAT scan?

If intravenous contrast material is to be used in the exam, the CT staff will need to know whether your child has had a reaction to contrast material in the past; is allergic to iodine or seafood; or has kidney disease. The purpose

of asking about allergies is to avoid a possibly serious allergic reaction.

Your child may eat and drink as usual and take needed medication as long as no contrast is to be given and no sedative (calming medication) or anesthesia is planned. If either of these situations applies, you may be advised about dietary restrictions or receive other instructions. With sedation or anesthesia your child probably will not be allowed to eat for three to six hours, depending on age, before scanning. In general, children who have recently been ill are not sedated or anesthetized. If this is the case or if you suspect that your child may be getting sick, you should call the CT staff to see whether the exam should be rescheduled.

For a head or neck scan you will have to remove your child's glasses, any removable dental braces or dentures and any jewelry. For a scan of any other part of the body, all metal objects should be removed from the area being examined.

What does the equipment look like?

The CT scanner is a large rectangular unit with a hole in its center, resembling a gigantic doughnut. Your child will lie on a motorized table set on tracks, which can move up or down and slide into and out of the central opening. Both the tube that emits the x-ray beam and the detectors that record radiation passing through the body are built into the scanner and are not visible to the patient. The computer that processes the CT images is in a remote location. The CT staff will be in a nearby room from which they control the scanner. Your child will be in constant sight via closed-circuit television or through a window into the CT room. Speakers and microphones inside the scanner will permit the technologist to hear and speak to your child as scanning proceeds. Some units have a call bell within reach so that you or your child can inform the technologist if any problems arise.

How does the procedure work?

Like conventional x-ray imaging, CT is based on the fact that different tissues, organs and disease-related changes in the body absorb x-rays to varying degrees. Both the standard radiograph (commonly called an x-ray) and the CT image represent a picture of the radiation that has passed through the body rather than being absorbed. What is different about CT scanning is that the images are cross-sectional "slices" of the area of the body suspected of being abnormal. The radiation passing through the body is recorded by a set of detectors that

rotate within the scanner and around the body. The resulting image data are processed using a special computer program that combines individual x-ray paths into detailed slices of the part of the body being examined.

Your child may receive contrast material by mouth, by rectum, by injection into a vein or by a combination of methods so that the organ or tissue being examined will be seen more clearly. Using contrast material also makes it easier to detect certain abnormalities affecting blood vessels.

How is the CAT scan performed?

After receiving oral or intravenous contrast material if needed and a sedative if judged necessary, your child will lie down on the scanner couch and be made as comfortable as possible. The head is supported in a cushion using soft straps to maintain alignment. The exact body position depends on what area is being scanned. You should encourage your child to report any discomfort during positioning because it is important to keep very still during the exam. Once the child is correctly positioned the CT staff will leave the room to begin the scan. For the first scans the couch will move through the scanner to determine its correct starting position for the rest of the scans. The table then will move more slowly as the actual CT scan is performed.

In adults, breath holding is an important way of obtaining high-quality CT images. Most children older than six years are able to hold their breath long enough to complete the scan although they may need coaching and practice. Younger children may be able to hold their breath when asked but are not as reliable as older children and may not be able to hold their breath long enough to complete the scan. Irregular breathing can affect the quality of a CT scan, especially one done to evaluate the chest or upper abdomen. It is often better to have young children breathe quietly and regularly during the scan. The technologist will help to decide about this. Modern systems known as multidetector or multislice CT are able to image large regions of the body in a very short time.

After the study is completed you may be asked to wait for a short time while the radiologist checks the scans to make sure they are clear enough to be easily interpreted. Occasionally it is necessary to have a few pictures repeated.

What will my child experience during the procedure?

Modern CT imaging avoids the start and stop noises made by the earlier scanners. This tended to disturb children more than the gentle, continuous movements of the scanner and table during more quiet spiral CT scanning. With modern imaging there are only slight buzzing, clicking or whirring sounds. Your child will need to lie quietly on his or her back. Foam cushions and Velcro straps are placed on the forehead and arms to prevent movement.

A CT scan may take as little as two seconds or as long as several minutes depending on the information needed. However, preparing for the study will take longer. Some imaging facilities permit parents or other adults to stay in the room when the scan is performed. In this case you must wear a lead-lined garment to avoid exposure to radiation. If you suspect you may be pregnant it would be better for someone else to be with your child. Many children are put off or even frightened by large machines and the general atmosphere of a medical facility; the presence of a parent, close relative or friend can be very reassuring.

If contrast material is injected into a vein, your child will feel warm all over but only for a brief time. There will likely be minor pain when the needle is placed into the vein; it is like getting a shot. When the exam is completed and your child—if sedated—is fully awake, you will be free to return home.

Some imaging facilities may use general anesthesia in young children who are unable to hold still. In this case you will be permitted to stay until your child has fallen asleep. There may be a somewhat longer wait after the exam to be sure that your child is fully alert.

Who interprets the results and how do we get them?

The CT images will be printed out from the computer or sent to a monitor and examined by a radiologist. The results should be available within 24 hours. The physician who recommended your child's exam will receive a detailed report by fax, mail or electronically and will in turn pass on the information to you. CT technologists are not trained to interpret the findings and it is not their responsibility to do so.

What are the benefits vs. risks?

Benefits

- CT provides detailed images of many regions of the body.
- Modern CT provides more detailed information than conventional x-rays for diagnosing many conditions, including disease of the lungs and airways, abdomen and brain. A major advantage of CT is that it is able to image bone, soft tissue and blood vessels all at the same time.
- Modern CT can also provide detailed information, including three-dimensional (3D) pictures of many parts of the body. This information can help to determine the presence and nature of abnormalities.
- Using a spiral (helical) CT unit to examine children is faster than the older CT scanners, reducing the need for sedation and general anesthesia. New technologies that will make even faster scanning possible are becoming increasingly available. For children this means shorter imaging times and less time required to hold still in order to produce clear images. Also, shorter scan times will make it easier for children to hold their breath during critical parts of the exam.

Risks

- Radiation is necessary to obtain CT images. It is known that high levels of radiation may cause cancer. However, CT scans result in a low-level exposure. Whether such levels cause cancer is debatable but because it is possible, every effort is made to limit the amount of radiation children may receive from a CT scan. The thyroid gland, bone marrow and gonads of a child are especially sensitive to radiation. In addition, children have a longer time to accumulate radiation throughout their lives. Each exposure, including that from a CT exam, adds to this total lifetime exposure.
- One of the best ways of limiting radiation exposure is to avoid CT scans that are not clearly needed. Other measures are to restrict the area scanned as much as possible and to "fine tune" the CT settings based on the reason for the exam, the body area being examined, and the child's size. Radiologists generally attempt to use the lowest radiation dose that will provide the needed diagnostic information.

Please see the Radiation Safety page on the RadiologyInfo.org Web site for more information.

- There always is a risk of complications from general anesthesia or sedation. Every measure will be taken to protect the welfare of your child, including close monitoring.
- Occasionally there can be a reaction to the contrast material injected into a vein. These reactions usually are allergic and may cause hives, other kinds of rash, itching or wheezing. Vomiting also is a possible side effect of intravenous contrast material. Severe or life-threatening reactions are extremely rare in children; they are less frequent than similar reactions to penicillin or a bee sting.

What are the limitations of Pediatric CT?

- Other imaging methods such as ultrasound or magnetic resonance (MR) imaging can provide pictures of certain areas of the body that sometimes are as good as or better than those obtained by CT scanning. Working together, your primary care physician or pediatrician and the radiologist will decide which type of examination is best for your child.
- Motion can affect the quality of a CT scan even when every effort is made to see that your child holds still.
- CT scans do require radiation although the lowest dose needed to obtain high-quality images will be used.
- Your child may require a needle-stick in order to inject contrast material into a vein.

Disclaimer:

This information is copied from the RadiologyInfo Web site (<http://www.radiologyinfo.org>) which is dedicated to providing the highest quality information. To ensure that, each section is reviewed by a physician with expertise in the area presented. All information contained in the Web site is further reviewed by an ACR (American College of Radiology) - RSNA (Radiological Society of North America) committee, comprising physicians with expertise in several radiologic areas.

However, it is not possible to assure that this Web site contains complete, up-to-date information on any particular subject. Therefore, ACR and RSNA make no representations or warranties about the suitability of this information for use for any particular purpose. All information is provided "as is" without express or implied warranty.

Please visit the RadiologyInfo Web site at <http://www.radiologyinfo.org> to view or download the latest information.

Copyright © 2005 Radiological Society of North America, Inc. Send comments via email to: webmast2@rsna.org
--