

Pediatric MRI for Appendicitis

Children's magnetic resonance imaging (MRI) for appendicitis uses a powerful magnetic field, radio waves and a computer to produce detailed pictures of the inside of your child's abdomen and pelvis. MRI may be used to help diagnose or evaluate symptoms associated with appendicitis because it is non-invasive, fast, and does not use ionizing radiation.

Talk with your doctor about your child's health problems, medications, recent surgeries and allergies. The magnetic field is not harmful, but it may cause certain medical devices to malfunction. Most orthopedic implants pose no risk, but you should always tell the technologist if your child has any implanted medical or electronic devices. Inform your doctor and the technologist prior to the exam if your child has a known allergy to contrast material. Your child should wear loose, comfortable clothing and may be asked to wear a gown.



What is Pediatric MRI?

Pediatric magnetic resonance imaging (MRI) is a noninvasive medical test that uses a powerful magnetic field, radio frequency pulses and a computer to produce detailed pictures of your child's organs, soft tissues, bone and internal body structures. Because MRI does not use ionizing radiation (x-rays), it is frequently used in diagnosing and evaluating disease and trauma in children.

Detailed MR images allow physicians to evaluate various parts of the body and determine the presence of certain diseases. The images may be examined on a computer monitor, transmitted electronically, printed, copied to a CD, or uploaded to a digital cloud server. *For more information, see the Children's (Pediatric) MRI (<https://www.radiologyinfo.org/en/info/pediatric-mri>) page.*

What is appendicitis?

Appendicitis is a condition that results from inflammation of the appendix. The appendix is a closed tube of tissue attached to the large intestine in the lower right part of the abdomen. Inflammation occurs when the appendix becomes infected or blocked by stool, calcification, foreign bodies or a tumor. If the appendix is inflamed and/or ready to burst, emergency care may be required. *For more information, see the Appendicitis (<https://www.radiologyinfo.org/en/info/appendicitis>) page.*

How is pediatric MRI used for appendicitis?

Children often initially undergo an ultrasound study to evaluate for appendicitis. In cases where the ultrasound study is not diagnostic, additional imaging may be recommended to diagnose appendicitis. Adults suspected of having appendicitis typically will undergo a computed tomography (CT) study, which uses x-rays to produce pictures of the inside of the body. However, in order to minimize the amount of radiation given to children, magnetic resonance imaging (MRI) may be recommended as an alternative to CT to diagnose appendicitis in children.

MRI is also useful in eliminating other possible causes of your child's pain, including:

- gastroenteritis – also known as "the stomach flu;" the stomach and intestine are irritated, causing pain, vomiting and diarrhea
- mesenteric lymphadenitis – lymph nodes in the membrane connecting the bowel to the abdominal wall are inflamed
- Meckel's diverticulum – there is a bulge or weakness in the wall of the small intestine

- inflammatory bowel disease – the digestive track is inflamed
- intestinal obstruction – there is a blockage in the intestine
- ovarian cysts
- urinary tract infection involving one or both kidneys (pyelonephritis).

How should I prepare my child for the MRI?

Your child may be asked to wear a gown during the exam or allowed to wear their own clothing if it is loose-fitting and has no metal fasteners.

Guidelines about eating and drinking before an MRI exam vary with the specific exam and also with the imaging facility. For appendicitis MRI in children, usually no additional preparation or instructions are required. Unless you are told otherwise, follow your child's regular daily routine and have them take food and medications as usual.

Some MRI examinations may require your child to receive an injection of contrast material into the bloodstream. The radiologist, technologist or a nurse may ask if your child has allergies of any kind, such as an allergy to iodine or x-ray contrast material, drugs, food, or the environment, or if your child has asthma. The contrast material most commonly used for an MRI exam contains a metal called gadolinium. Gadolinium can be used in patients with iodine contrast allergy, but may require pre-medication. It is far less common for a patient to have an allergy to a gadolinium-based contrast agent used for MRI than the iodine-containing contrast for CT or x-ray. However, even if you know your child has an allergy to the gadolinium contrast, it may still be possible to use it after appropriate pre-medication. *For more information on adverse reactions to gadolinium-based contrast agents, please consult the ACR Manual on Contrast Media (<https://www.acr.org/Clinical-Resources/Contrast-Manual>) and/or see the Contrast Materials (<https://www.radiologyinfo.org/en/info/safety-contrast>) page.*

Tell the radiologist if your child has any serious health problems or has recently had surgery. Some conditions, such as severe kidney disease, may prevent your child from being given gadolinium contrast for an MRI. If your child has a history of kidney disease or liver transplant, it will be necessary to perform a blood test to determine whether the kidneys are functioning adequately.

Also, inform your doctor of any recent illnesses or other medical conditions your child may have, and if there is a history of heart disease, asthma, diabetes, kidney disease or thyroid problems. Any of these conditions may influence the decision on whether contrast material will be given to your child for the MRI examination.

Jewelry and other accessories should be left at home, if possible, or removed prior to the MRI scan. Because they can interfere with the magnetic field of the MRI unit, metal and electronic items are not allowed in the exam room. These items include:

- jewelry, watches, credit cards and hearing aids, all of which can be damaged
- pins, hairpins, metal zippers and similar metallic items, which can distort MRI images
- removable dental work
- pens, pocket knives and eyeglasses
- body piercings

In most cases, an MRI exam is safe for patients with metal implants. Some institutions may not perform MRI imaging on patients with:

- cochlear (ear) implant
- some types of clips used for brain aneurysms
- some types of metal coils placed within blood vessels
- cardiac defibrillators and pacemakers.

Tell the technologist if your child has any implanted medical or electronic devices. These objects may interfere with the exam or potentially pose a risk, depending on their nature and the strength of the MRI magnet.

In general, metal objects used in orthopedic surgery pose no risk during MRI. However, a recently placed artificial joint may require the use of another imaging procedure. If there is any question of the presence of metal objects, an x-ray may be taken to detect and identify them.

You should notify the technologist or radiologist of any shrapnel, bullets, or other pieces of metal which may be present in your child's body due to prior accidents. Foreign bodies near and especially lodged in the eyes are particularly important. Tooth fillings and braces usually are not affected by the magnetic field, but the radiologist or technologist should still be made aware of them.

Parents or family members who accompany children into the scanning room also need to remove all metal objects and notify the technologist of any medical or electronic devices they may have.

If your child has claustrophobia (fear of enclosed spaces) or anxiety, you may want to talk to your pediatrician about obtaining a prescription for a mild sedative prior to the scheduled examination.

Most children five and older are able to stay adequately still during the exam without sedation. Timing is critical when diagnosing severe abdominal pain. Therefore, most hospitals try to avoid sedation if possible so that they can get test results quickly.

What does the MRI equipment look like?

The traditional MRI unit is a large cylinder-shaped tube surrounded by a circular magnet. Your child will lie on a moveable examination table that slides into the center of the magnet.

Some MRI units, called short-bore systems, are designed so that the magnet does not completely surround the patient. Some newer MRI machines have a larger diameter bore which can be more comfortable for larger size patients or patients with claustrophobia. Other MRI machines are open on the sides (open MRI). Open units are especially helpful for examining larger patients or those with claustrophobia. Newer open MRI units provide very high quality images for many types of exams; however, older open MRI units may not provide this same image quality. Certain types of exams cannot be performed using open MRI. For more information, consult your radiologist.

The computer workstation that processes the imaging information is located in a separate room from the scanner.

How does the procedure work?

Unlike conventional x-ray examinations and computed tomography (CT) scans, MRI does not use ionizing radiation. Instead, radiofrequency pulses re-align hydrogen atoms that naturally exist within the body while your child is in the scanner without causing any chemical changes in the tissues. As the hydrogen atoms return to their usual alignment, they emit different amounts of energy that vary according to the different types of body tissue. The MR scanner captures this energy and creates a picture of the tissues scanned based on this information.

In most MRI units, the magnetic field is produced by passing an electric current through wire coils. Other coils, located in the machine and, in some cases, placed around the part of the body being imaged, send and receive radio waves, producing signals that are detected by the coils. The electric current does not come in contact with the patient.

A computer processes the signals and generates a series of images, each of which shows a thin slice of your child's body. The images can then be studied from different angles by the radiologist.

How is the procedure performed?

MRI exams may be done on an outpatient basis.

Your child will be positioned on the moveable examination table. Straps and bolsters may be used to help your child stay still and maintain the correct position during imaging.

The technologist may place devices that contain coils capable of sending and receiving radio waves around or next to the area of the body under examination.

MRI exams generally include multiple runs (sequences), some of which may last several minutes. Each run will create a different set of noises.

If a contrast material is used in the MRI exam, a physician, nurse or technologist will insert an intravenous (IV) catheter (IV line) into a vein in your child's hand or arm. A saline solution may be used to inject the contrast material. The solution will drip through the IV to prevent blockage of the IV catheter until the contrast material is injected.

Your child will be placed into the magnet of the MRI unit and the radiologist and technologist will perform the examination while working at a computer outside of the room.

If your exam uses a contrast material, the technologist will inject it into the intravenous line (IV) after an initial series of scans. They will take more images during or following the injection.

When the examination is complete, you and your child may be asked to wait until the technologist or radiologist checks the images in case additional images are needed.

Your child's intravenous line will be removed.

MRI exams generally include multiple runs (sequences), some of which may last several minutes.

What will my child experience during and after the procedure?

Your child will usually be alone in the exam room during the MRI procedure. However, the technologist will be able to see, hear and speak with your child at all times using a two-way intercom. Many MRI centers allow a parent to stay in the room as long as they have been screened for safety in the magnetic environment.

MRI scanners are air-conditioned and well-lit. Children will be given appropriately sized earplugs or headphones during the exam. Music may be played through the headphones to help your child pass the time. Some scanners are equipped with video monitors so that your child may watch a movie or TV show during the exam.

It is normal for the area of your child's body being imaged to feel slightly warm, but if your child is bothered by the sensation, they will be able to notify the radiologist or technologist through the two-way intercom. It is important that your child remain perfectly still while the images are being obtained, which is typically only a few seconds to a few minutes at a time. Your child will know when images are being recorded because he/she will hear and feel loud tapping or thumping sounds when the coils that generate the radiofrequency pulses are activated. Your child will be able to relax between imaging sequences, but will be asked to maintain their position without moving as much as possible.

In some cases, an IV injection of contrast material may be performed. The IV needle may cause your child some discomfort when it is inserted, and your child may experience some bruising. There is also a very small chance of skin irritation at the site of the IV tube insertion. Some patients may sense a temporary metallic taste in their mouth after the contrast injection.

If sedation has not been used, no recovery period is necessary, and your child may resume their usual activities and normal diet immediately after the exam. A few patients experience side effects from the contrast material, including nausea and local pain. Very rarely, patients are allergic to the contrast material and experience hives, itchy eyes or other reactions. If your child

experiences allergic symptoms, a radiologist or other physician will be available for immediate assistance.

Who interprets the results and how do we get them?

A radiologist, a doctor trained to supervise and interpret radiology exams, will analyze the images. The radiologist will send a signed report to your primary care or referring physician, who will share the results with you.

What are the benefits vs. risks?

Benefits

- MRI is a noninvasive imaging technique that does not involve exposure to radiation.
- MR imaging of the abdomen has been shown to be as effective in diagnosing appendicitis as CT scans but without the radiation exposure.
- MRI has proven valuable in diagnosing a broad range of conditions.
- MRI can identify abnormalities that might be obscured by bone with other imaging methods.
- The MRI gadolinium contrast material is less likely to cause an allergic reaction than the iodine-based contrast materials used for x-rays and CT scanning.

Risks

- The MRI examination poses almost no risk to the average patient when appropriate safety guidelines are followed.
- If sedation is used, there are risks of excessive sedation. However, the technologist or nurse monitors your child's vital signs to minimize this risk.
- Although the strong magnetic field is not harmful in itself, implanted medical devices that contain metal may malfunction or cause problems during an MRI exam.
- Nephrogenic systemic fibrosis is currently a recognized, but rare, complication of MRI believed to be caused by the injection of high doses of gadolinium-based contrast material in patients with very poor kidney function. Screening for adequate kidney function before considering a contrast injection minimizes the risk of this very rare complication.
- There is a very slight risk of an allergic reaction if contrast material is injected. Such reactions usually are mild and easily controlled by medication. If your child experiences allergic symptoms, a radiologist or other physician will be available for immediate assistance.

What are the limitations of Pediatric MRI for appendicitis?

High-quality images are assured only if your child is able to remain perfectly still and follow breath-holding instructions while the images are being recorded. If your child is anxious, confused or in severe pain, they may find it difficult to lie still during imaging.

A person who is very large may not fit into the opening of certain types of MRI machines.

The presence of an implant or other metallic object sometimes makes it difficult to obtain clear images. Patient movement can have the same effect.

MRI typically costs more and may take more time to perform than other imaging exams.

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