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For patients

Pediatric MRI

Children's magnetic resonance imaging (MRI) uses a powerful magnetic field, radio waves and a computer to produce detailed pictures of the inside of your child's body. MRI may be used to help diagnose or monitor treatment for a variety of conditions within the brain, chest, abdomen, pelvis and extremities.

Tell your doctor about your child's health problems, medications, recent surgeries and allergies. The magnetic field is not harmful, but it may cause some 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. You may be instructed to withhold food or drink beforehand, especially if anesthesia is to be used. In general, children who have recently been ill will not be given anesthesia. If this is the case, or if you suspect your child may be getting sick, talk to your physician about rescheduling the exam.

What is pediatric MRI?

Magnetic resonance imaging (MRI) is a noninvasive test doctors use to diagnose medical conditions.

MRI uses a powerful magnetic field, radiofrequency pulses, and a computer to produce detailed pictures of internal body structures. MRI does not use radiation (x-rays).

Detailed MR images allow doctors to examine the body and detect disease.

What are some common uses of the procedure?

MRI is used to help diagnose a wide range of conditions in children due to injury, illness or congenital abnormalities.

When imaging of a child's brain and spinal cord is needed, MRI is useful because of its ability to see through the skull and the bones of the skull and spine without radiation. MRI of the brain and spine is used to:

- detect a variety of brain conditions and abnormalities like cysts, tumors, bleeding, swelling, or problems with the blood vessels
- detect damage to the brain caused by an injury or a stroke
- diagnose infectious or autoimmune diseases like encephalopathy (http://www.radiologyinfo.org) or encephalitis (http://www.radiologyinfo.org)
- evaluate problems such as persistent headaches, dizziness, weakness, blurry vision or seizures
- help detect certain chronic diseases of the nervous system, such as multiple sclerosis (http://www.radiologyinfo.org)
- diagnose problems with the pituitary gland (http://www.radiologyinfo.org) and brainstem (http://www.radiologyinfo.org)
- assess the cause of developmental delay
- identify and evaluate degenerated or herniated spinal discs
- evaluate the bones of the spine for congenital or acquired abnormalities

- determine the condition of nerve tissue within the spinal cord

In the heart, MRI is often used in a complementary role to echocardiography (heart ultrasound), computed tomography (http://www.radiologyinfo.org) and catheter angiography (https://www.radiologyinfo.org/en/info/angiocath) to provide information both before and after treatment. Cardiac MRI may be used to:

- evaluate the structure of the heart and surrounding blood vessels
- assess causes of arrhythmia (abnormal heart rhythm)
- evaluate infections
- assess blood flow to the heart muscle
- evaluate findings following cardiovascular surgery

In the abdominal and pelvic region, MRI is used to:

- diagnose causes of pain including evaluation for appendicitis
- evaluate for injury after trauma
- diagnose and monitor infectious or inflammatory disorders
- monitor response to cancer treatment

MRI is often the best choice for imaging the joints and bones, where it can help:

- diagnose sports-related injuries
- detect the presence of an otherwise hidden tumor or infection in a joint
- diagnose developmental joint abnormalities in children
- detect bone cancer
- inspect the marrow for leukemia and other diseases
- assess bone loss
- examine complex fractures

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. Unless you are told otherwise, follow your child's regular daily routine and have him/her 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 (http://www.radiologyinfo.org) , technologist (http://www.radiologyinfo.org) 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 (http://www.radiologyinfo.org) . 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. 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.

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

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. Many implanted devices will have a pamphlet explaining the MRI risks for that particular device. If you have the pamphlet, it is useful to bring that to the attention of the technologist or scheduler before the exam. Some cochlear implants can be scanned, but there are preparations needed. Some implanted devices require a short period of time after placement (usually six weeks) before being safe for MRI examinations. Examples include but are not limited to:

- cochlear (ear) implant
- clips used for brain aneurysms (http://www.radiologyinfo.org)
- metal coils placed within blood vessels
- cardiac defibrillators (http://www.radiologyinfo.org) and pacemakers (http://www.radiologyinfo.org)
- artificial heart valves
- implanted drug infusion ports
- artificial limbs or metallic joint prostheses
- implanted nerve stimulators
- metal pins, screws, plates, stents or surgical staples

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 their presence, an x-ray may be taken to detect and identify any metal objects.

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 they may distort images of the facial area or brain, so the radiologist should be aware of them.

Anyone accompanying a patient into the exam room must also undergo screening for metal objects and implanted devices.

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.

Your child may need to be sedated in order to hold still adequately during the procedure. If this is the case, you will be given instructions for your child about not eating or drinking several hours prior to sedation and the examination. For the safety of your

child during the sedation, it is important that you fully understand and follow any instructions that have been given. After the procedure there will be a recovery period from the sedation. Your child will be discharged when the nurses and physicians believe they are sufficiently awake to be safely sent home.

In general, children who have recently been ill will not be sedated or anesthetized. If this is the case, or if you suspect your child may be getting sick, talk to your physician about rescheduling the exam. When scheduling the exam for a young child, ask if a child life specialist is available. A child life specialist is trained to make your child comfortable and less anxious without sedation and will help your child to remain still during the examination.

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 are designed so that the magnet does not completely surround you. Some newer MRI machines have a larger diameter 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 where the technologist works to set up the images is located in a separate room from the scanner.

How does the procedure work?

Unlike x-ray and computed tomography (CT) exams, MRI does not use radiation. Instead, radio waves re-align hydrogen atoms that naturally exist within the body. This does not cause any chemical changes in the tissues. As the hydrogen atoms return to their usual alignment, they emit different amounts of energy depending on the type of tissue they are in. The scanner captures this energy and creates a picture using this information.

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

A computer processes the signals and creates a series of images, each of which shows a thin slice of the body. The radiologist can study these images from different angles.

MRI is often able to tell the difference between diseased tissue and normal tissue better than x-ray, CT, and ultrasound.

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 will be used in the MRI exam, a physician, nurse or technologist will insert an intravenous

(IV) (http://www.radiologyinfo.org) catheter, also known as an 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.

The doctor may also perform MR spectroscopy during your exam. MR spectroscopy provides additional information on the chemicals present in the body's cells. This may add about 15 minutes to the total exam time.

What will my child experience during and after the procedure?

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

Children will be given appropriately sized earplugs or headphones during the exam. MRI scanners are air-conditioned and well-lit. 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, he/she will be able to talk to 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. Your child will be able to relax between imaging sequences, but will be asked to maintain his/her position without movement as much as possible.

In some cases, intravenous injection of contrast material may be performed. The intravenous 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.

Follow-up examinations may be necessary, and your doctor will explain the exact reason why another exam is needed. Sometimes a follow-up exam is done because a suspicious or questionable finding needs clarification with additional views or a special

imaging technique. A follow-up examination may also be necessary so that any change in a known abnormality can be monitored over time. Follow-up examinations are sometimes the best way to see if treatment is working or if an abnormality is stable or changed over time.

What are the benefits vs. risks?

Benefits

- MRI is a noninvasive imaging technique that does not involve exposure to radiation.
- MR imaging of the soft-tissue structures of the body—such as the heart, liver and many other organs—is more likely in some instances to identify and accurately characterize diseases than other imaging methods. This detail makes MRI an invaluable tool in early diagnosis and evaluation of many focal lesions and tumors
- MRI has proven valuable in diagnosing a broad range of conditions, including cancer, heart and vascular disease, and muscular and bone abnormalities
- MRI provides a noninvasive alternative to x-ray, angiography and CT for diagnosing problems of the heart and blood vessels
- MRI can detect 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, a nurse or physician 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 (http://www.radiologyinfo.org) is currently a recognized, but rare, complication believed to be caused by the injection 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 you experience allergic symptoms, a radiologist or other physician will be available for immediate assistance.
- After undergoing an MRI examination, small amounts of gadolinium contrast material may remain in the patient's body, including the brain. Gadolinium retention has not been shown to be harmful to patients with normal kidney function, and the benefit of an accurate diagnosis far outweighs any potential risk.

What are the limitations of Pediatric MRI?

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, he/she 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.

A very irregular heartbeat may affect the quality of images obtained using techniques that time the imaging based on the electrical activity of the heart, such as electrocardiography (ECG).

An MRI exam typically costs more and may take more time than other imaging exams. Talk to your insurance provider if you have concerns about the cost of MRI.

MRI is generally not recommended for seriously injured patients. However, this decision is based on clinical judgment. This is because traction devices and life support equipment may distort the MR images. As a result, they must be kept away from the area to be imaged. Some trauma patients, however, may need MRI.

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