Urography

Urography uses imaging and contrast material to evaluate or detect blood in urine, kidney or bladder stones, and cancer in the urinary tract. Urography with conventional x-ray is known as intravenous pyelogram (IVP). Urography is also often performed using computed tomography (CT) or magnetic resonance imaging (MRI). CT and MR urography are painless and proven effective in detecting urinary tract issues.

Your preparation may vary depending on whether your exam will use CT or MRI. Tell your doctor if there's a possibility you are pregnant and discuss any recent illnesses, medical conditions, medications you're taking, and allergies – especially to contrast materials. Your doctor may instruct you to not eat or drink anything several hours beforehand. In order to distend your urinary bladder, you may be asked to drink water prior to the exam and not to urinate until your scan is complete. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.

What is Urography?

Urography is an examination used to evaluate the kidneys (http://www.radiologyinfo.org) , ureters (http://www.radiologyinfo.org) and bladder (http://www.radiologyinfo.org) . Excretory urography, also known as intravenous pyelogram (http://www.radiologyinfo.org) , is performed using conventional x-ray after the intravenous (http://www.radiologyinfo.org) administration of radiographic contrast material (http://www.radiologyinfo.org) . This technique is still performed for pediatric patients and occasionally for younger adult patients.

Computed tomography (http://www.radiologyinfo.org) (CT) urography and magnetic resonance (http://www.radiologyinfo.org) (MR) urography use CT and MR images, respectively, after intravenous contrast material to obtain images of the urinary tract. CT urography (CTU) and MR urography (MRU) are used as primary imaging techniques to evaluate patients with blood in the urine (hematuria), follow patients with prior history of cancers of the urinary collecting system and to identify abnormalities in patients with recurrent urinary tract infections. In addition to imaging the urinary tract, CT and MR urography can provide valuable information about other abdominal and pelvic structures and diseases that may affect them.

What are some common uses of the procedure?

Urography images are used to evaluate issues or detect abnormalities in portions of the urinary tract, including the kidneys, bladder and ureters, including:

- Hematuria (blood in urine)
- Kidney or bladder stones
- Cancers (http://www.radiologyinfo.org) of the urinary tract

How should I prepare?

CT Urography

If your physician has ordered a CT urography exam, you should wear comfortable, loose-fitting clothing to your exam. You may be given a gown to wear during the procedure.

Metal objects including jewelry, eyeglasses, dentures and hairpins may affect the CT images and should be left at home or removed prior to your exam. You may also be asked to remove hearing aids and removable dental work. Women will be asked to remove bras containing metal underwire. In order to distend your urinary bladder, you may be asked to drink water prior to the examination, and also not to urinate until after the scan is complete. However, guidelines about eating and drinking before a CT exam vary with the specific exam and also with the facility.

You may be asked not to eat or drink anything for several hours before the exam, especially if a contrast material will be used. You should inform your physician of any medications you are taking and if you have any allergies. If you have a known allergy to contrast material, inform your doctor. Based on your allergic history, your doctor may decide to provide medications to reduce the risk of allergic reaction or decide to cancel your exam.

Also, inform your doctor of any recent illnesses or other medical conditions, and if you have a history of heart disease (particularly congestive heart failure or hypertension), asthma, diabetes, kidney disease, prior organ transplantation, use of chronic NSAIDS (e.g., Motrin), anti-rejection medication or certain antibiotics. Any of these conditions or medications may increase the risk of an unusual adverse effect following the administration of contrast for CT urography.

Women should always inform their physician and the CT technologist if there is any possibility that they are pregnant. *See the CT Safety During Pregnancy (https://www.radiologyinfo.org/en/info/safety-ct-pregnancy) page for more information about pregnancy and CT.*

MR Urography

If you are scheduled for an MR urography exam, you may be asked to wear a gown during the exam or you may be allowed to wear your own clothing if it is loose-fitting and has no metal fasteners.

In order to distend your urinary bladder, you may be asked to drink water prior to the examination, and also not to urinate until after the scan is complete. However, guidelines about eating and drinking before an MRI exam vary with the specific exam and also with the facility. For some types of exams, you will be asked to fast for eight to 12 hours. Unless you are told otherwise, you may follow your regular daily routine and take medications as usual.

If you are scheduled to undergo MR urography, you may have contrast material injected intravenously for the exam. The radiologist (http://www.radiologyinfo.org) or technologist (http://www.radiologyinfo.org) may ask if you have asthma or allergies of any kind, such as an allergy to gadolinium drugs, certain foods or the environment.

The radiologist should also know if you have any serious health problems or if you have recently had surgery. Some conditions, such as severe kidney disease, may prevent you from being given gadolinium for an MRI. If there is a history of severe kidney disease, it may be necessary to perform a blood test to determine whether the kidneys are functioning adequately.

Women should always tell their doctor and technologist if they are pregnant. MRI has been used since the 1980s with no reports of any ill effects on pregnant women or their unborn babies. However, the baby will be in a strong magnetic field. Therefore, pregnant women should not have an MRI in the first trimester unless the benefit of the exam clearly outweighs any potential risks. Pregnant women should not receive gadolinium contrast unless absolutely necessary. *See the MRI Safety During Pregnancy (https://www.radiologyinfo.org/en/info/safety-mri-pregnancy) page for more information about pregnancy and MRI.*

If you have claustrophobia (http://www.radiologyinfo.org) (fear of enclosed spaces) or anxiety, ask your doctor to prescribe a mild sedative prior to the date of your exam.

With advance notice and planning, some medical centers can provide conscious sedation for patients with claustrophobia. Patients will typically need to avoid eating for six hours and drinking for two hours prior to sedation. Consult with your referring physician

and imaging center if conscious sedation may be required.

Leave all jewelry and other accessories at home or remove them prior to the MRI scan. Metal and electronic items are not allowed in the exam room. They can interfere with the magnetic field of the MRI unit, cause burns, or become harmful projectiles. 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, pocketknives, and eyeglasses
- body piercings
- mobile phones, electronic watches, and tracking devices.

In most cases, an MRI exam is safe for patients with metal implants, except for a few types. People with the following implants may not be scanned and should not enter the MRI scanning area without first being evaluated for safety:

- some cochlear (ear) implants
- some types of clips used for brain aneurysms (http://www.radiologyinfo.org)
- some types of metal coils placed within blood vessels
- some older cardiac defibrillators (http://www.radiologyinfo.org) and pacemakers (http://www.radiologyinfo.org)
- vagal nerve stimulators

Tell the technologist if you have medical or electronic devices in your body. These devices may interfere with the exam or pose a risk. Many implanted devices will have a pamphlet explaining the MRI risks for that device. If you have the pamphlet, bring it to the attention of the scheduler before the exam. MRI cannot be performed without confirmation and documentation of the type of implant and MRI compatibility. You should also bring any pamphlet to your exam in case the radiologist or technologist has any questions.

If there is any question, an x-ray can detect and identify any metal objects. Metal objects used in orthopedic surgery generally pose no risk during MRI. However, a recently placed artificial joint may require the use of a different imaging exam.

Tell the technologist or radiologist about any shrapnel, bullets, or other metal that may be in your body. Foreign bodies near and especially lodged in the eyes are very important because they may move or heat up during the scan and cause blindness. Dyes used in tattoos may contain iron and could heat up during an MRI scan. This is rare. The magnetic field will usually not affect tooth fillings, braces, eyeshadows, and other cosmetics. However, these items may distort images of the facial area or brain. Tell the radiologist (http://www.radiologyinfo.org) about them.

Children younger than teenagers may need to be sedated in order to hold still for the procedures. Parents should ask about this beforehand and be made aware of food and drink restrictions that may be needed prior to sedation

What does the equipment look like?

CT scanner

The CT scanner is typically a large, donut-shaped machine with a short tunnel in the center. You will lie on a narrow table that slides in and out of this short tunnel. Rotating around you, 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 in a separate control room. This is where the technologist operates the scanner and monitors your exam in direct visual contact. The technologist will be able to hear and talk to you using a speaker and microphone.

MRI scanner

The traditional MRI unit is a large cylinder-shaped tube surrounded by a circular magnet. You will lie on a table that slides into a tunnel towards the center of the magnet.

Some MRI units, called short-bore systems (http://www.radiologyinfo.org) , are designed so that the magnet does not completely surround you. Some newer MRI machines have a larger diameter bore, which can be more comfortable for larger patients or those with claustrophobia. "Open" MRI units are open on the sides. They are especially helpful for examining larger patients or those with claustrophobia. Open MRI units can provide high quality images for many types of exams. Open MRI may not be used for certain exams. For more information, consult your radiologist.

How does the procedure work?

CT scanning 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.

In many ways, a CT scan works like other x-ray exams. Different body parts absorb x-rays in different amounts. This difference allows the doctor to distinguish body parts from one another on an x-ray or CT image.

A conventional x-ray exam directs a small amount of radiation through the body part under examination. A special electronic image recording plate captures the image. Bones appear white on the x-ray. Soft tissue, such as the heart or liver, shows up in shades of gray. Air appears black.

With CT scanning, several x-ray beams and electronic x-ray detectors rotate around you. These measure the amount of radiation being absorbed throughout your body. Sometimes, the exam table will move during the scan. A special computer program processes this large volume of data to create two-dimensional cross-sectional images of your body. The system displays the images on a computer monitor. CT imaging is sometimes compared to looking into a loaf of bread by cutting the loaf into thin slices. When the computer software reassembles the image slices, the result is a very detailed multidimensional view of the body's interior.

Nearly all CT scanners can obtain multiple slices in a single rotation. These multi-slice (multidetector) CT scanners obtain thinner slices in less time. This results in more detail.

Modern CT scanners can image large sections of the body in just a few seconds, and even faster in small children. Such speed is beneficial for all patients. Speed is especially beneficial for children, the elderly, and critically ill – anyone who finds it difficult to stay still, even for the brief time necessary to obtain images.
For children, the radiologist will adjust the CT scanner technique to their size and the area of interest to reduce the radiation dose.

MRI uses a powerful magnetic field, radiofrequency pulses and a computer to produce detailed pictures of organs, soft tissues, bone and virtually all other internal body structures. The images can then be examined on a computer monitor, transmitted electronically, printed or copied to a CD. MRI does not use ionizing radiation (http://www.radiologyinfo.org) (x-rays).

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?

Both CT and MR urography are usually done on an outpatient basis.

If CT urography is being performed, the technologist will begin by positioning you on the CT examination table, usually lying flat on your back or possibly on your side or stomach. You may be asked to change positions during portions of the examination. Straps and pillows may be used to help you maintain the correct position and to hold still during the exam.

Many scanners are fast enough to scan children without sedation. In special cases, children who cannot hold still may need sedation. Motion may cause blurring of the images and degrade image quality the same way that it affects photographs.

If contrast material is used, a nurse or technologist will inject the contrast through an IV line placed in the hand or arm.

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 for the actual CT scan. Depending on the type of CT scan, the machine may make several passes.

The technologist may ask you to hold your breath during the scanning. Any motion, including breathing and body movements, can lead to artifacts (http://www.radiologyinfo.org) on the images. This loss of image quality can resemble the blurring seen on a photograph taken of a moving object.

When the exam is complete, the technologist will ask you to wait until they verify that the images are of high enough quality for accurate interpretation by the radiologist.

CT exams are generally painless, fast, and easy. Multidetector CT reduces the amount of time that the patient needs to lie still.

If MR urography is being performed, the technologist will begin by positioning you on the MRI examination table, usually lying flat on your back or possibly on your side or stomach. You may be asked to change positions during portions of the examination. Straps and bolsters may be used to help you maintain the correct position and to hold still 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 nurse or technologist will insert an intravenous (IV) line into a vein in your hand or arm. You will be moved into the magnet of the MRI unit, and the radiologist and technologist will leave the room while the MRI examination is performed.

When the exam is complete, the technologist may ask you to wait while the radiologist checks the images in case more are needed.

The technologist will remove your IV line after the exam is over and place a small dressing over the insertion site.

What will I experience during and after the procedure?

If your urography exam involves CT:

If the exam uses iodinated contrast material, your doctor will screen you for chronic or acute kidney disease. The doctor may administer contrast material intravenously (by vein), so you will feel a pin prick when the nurse inserts the needle into your vein. You may feel warm or flushed as the contrast is injected. You also may have a metallic taste in your mouth. This will pass. You may feel a need to urinate. However, these are only side effects of the contrast injection, and they subside quickly.

When you enter the CT scanner, you may see special light lines projected onto your body. These lines help ensure that you are in the correct position on the exam table. With modern CT scanners, you may hear slight buzzing, clicking and whirring sounds. These occur as the CT scanner's internal parts, not usually visible to you, revolve around you during the imaging process.

You will be alone in the exam room during the CT scan, unless there are special circumstances. For example, sometimes a parent wearing a lead shield may stay in the room with their child. However, the technologist will always be able to see, hear and speak with you through a built-in intercom system.

With pediatric patients, a parent may be allowed in the room but may need to wear a lead apron to minimize radiation exposure.

After a CT exam, the technologist will remove your intravenous line. They will cover the tiny hole made by the needle with a small dressing. You can return to your normal activities immediately.

If your urography exam involves MR:

It is normal for the area of your body being imaged to feel slightly warm. If it bothers you, tell the radiologist or technologist. It is important that you remain perfectly still while the images are being taken. This is typically only a few seconds to a few minutes at a time. You will know when images are being recorded because you will hear and feel loud tapping or thumping sounds. The coils that generate the radio waves make these sounds when they are activated. You will be provided with earplugs or headphones to reduce the noise made by the scanner. You may be able to relax between imaging sequences. However, you will need to keep the same position as much as possible without moving.

You will usually be alone in the exam room. However, the technologist will be able to see, hear, and speak with you at all times using a two-way intercom. They will give you a “squeeze-ball” that alerts the technologist that you need attention right away. Many facilities allow a friend or parent to stay in the room if they have also been screened for safety.

Children will be given appropriately sized earplugs or headphones during the exam. Music may be played through the headphones to help pass the time. MRI scanners are air-conditioned and well-lit.

In some cases, IV injection of contrast material may be given before the images are obtained. The IV needle may cause you some discomfort and you 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 have a temporary metallic taste in their mouth after the contrast injection.

If you do not require sedation, no recovery period is necessary. You may resume your usual activities and normal diet immediately after the exam. On very rare occasions, a few patients experience side effects from the contrast material. These may include nausea, headache, and pain at the site of injection. It is very rare that patients experience hives, itchy eyes, or other allergic reactions to the contrast material. If you have allergic symptoms, tell the technologist. A radiologist or other doctor will be available for immediate assistance.

Who interprets the results and how do I get them?

A radiologist (https://www.radiologyinfo.org/en/info/article-your-radiologist) , a doctor specially trained to supervise and interpret radiology exams, will analyze the images. The radiologist will send an official report to the doctor who ordered the exam.

What are the benefits vs. risks?

Benefits

- Both CT and MR urography have been proven effective in detecting issues or abnormalities in parts of the urinary tract including the kidneys, bladder and ureters, or as a follow-up test to further examine for recurrent or new cancers of the urinary tract.
- Compared to other imaging tests, CT and MR urography both provide superior anatomic detail of the urinary tract and surrounding structures.

Exams involving CT imaging:

- 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 exams 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.
- Unlike MRI, an implanted medical device of any kind will not prevent you from having a CT scan.
- CT imaging provides real-time imaging, making it a good tool for guiding needle biopsies (http://www.radiologyinfo.org) and needle aspirations (http://www.radiologyinfo.org) . This is particularly true of procedures involving the lungs, abdomen, pelvis, and bones.
- A diagnosis via CT scan may eliminate the need for exploratory surgery and surgical biopsy.
- No radiation remains in a patient's body after a CT exam.
- The x-rays used for CT scanning should have no immediate side effects.

Exams involving MR imaging:

- MRI is a noninvasive imaging technique that does not involve exposure to radiation.
- 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

Exams involving CT imaging:

- There is always a slight chance of cancer from excessive exposure to radiation. However, the benefit of an accurate diagnosis far outweighs the risk involved with CT scanning.
- Because children are more sensitive to radiation, they should have a CT exam only if it is essential for making a diagnosis. They should not have repeated CT exams unless necessary. CT scans in children should always be done with low-dose technique.

Exams involving MR imaging:

- The MRI examination poses almost no risk to the average patient when appropriate safety guidelines are followed.
- 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 (NSF) is currently a recognized, but extremely rare, complication of MRI believed to be caused by the injection of high doses of gadolinium contrast material in patients with very poor kidney function. However, more commonly used types of gadolinium contrast material have negligible, if any risk of NSF and can even be administered to patients with end-stage renal disease on dialysis.

Exams involving contrast material:

- IV contrast manufacturers indicate mothers should not breastfeed their babies for 24-48 hours after contrast material is given. However, the most recent American College of Radiology (ACR) Manual on Contrast Media reports that studies show the amount of contrast absorbed by the infant during breastfeeding is extremely low. *For further information please consult the ACR Manual on Contrast Media (https://www.acr.org/Clinical-Resources/Contrast-Manual) and its references.*
- 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.

What are the limitations of Urography?

A person who is very large may not fit into the opening of a conventional CT scanner. Or, they may be over the weight limit—usually 450 pounds—for the moving table.

High-quality images depend on your ability to remain perfectly still and follow breath-holding instructions while the images are being recorded. If you are anxious, confused or in severe pain, you may find it difficult to lie still during imaging.

A person who is very large may not fit into certain types of MRI machines. There are weight limits on the scanners.

Implants and other metallic objects can make it difficult to obtain clear images. Patient movement can have the same effect.

A very irregular heartbeat may affect the quality of images. This is because some techniques time the imaging based on the electrical activity of the heart.

MRI may not always distinguish between cancer tissue and fluid, known as edema (http://www.radiologyinfo.org) .

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.

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