

Medical Devices That Change World

Sarthak Kulshrestha

January/28/2022



NIT RAIPUR

Under Supervision-Dr Saurabh Gupta

Contents

1	Audiometer	2
1.1	Types of Audiometer	2
1.2	Types Of Audiometry	2
1.3	Advantages and Disadvantages-	3
2	Pacemaker-	4
2.1	Types Of pacemaker	4
2.2	Function-	4
2.2.1	Procedure	4
2.3	Risk And Precautions	5
3	Capsule Endoscopy	6
3.1	Significance of Capsule Endoscopy	6
3.2	Risk-	6
3.3	Other Information-	7
4	Magnetic Resonance Imaging-	8
4.1	Used for Diagnosis	8
4.2	Procedure	8
5	Ultrasound	10
5.1	Used for Diagnosis	10
5.2	Procedure	11

1 Audiometer

Audiometer is a device used for evaluating hearing acuity or hearing threshold of person. An audiologist or train person use special audiometric testing techniques to determine hearing threshold and hearing loss of a person.

1.1 Types of Audiometer

In audiometers we differentiate between screening audiometers, diagnostic audiometers and clinical audiometers. A screening audiometer is used to identify a potential hearing deficiency. A failed screening would require a referral for a full diagnostic test battery. A diagnostic audiometer would be the first device used in the full diagnostic test battery. It is used to identify and quantify hearing disorders as well as their possible origins and therefore has more functions and flexibility than the screening audiometer.

1.2 Types Of Audiometry

1-Pure-tone audiometry- Pure-tone audiometry is considered to be the gold standard in the evaluation of auditory sensitivity. The extent of hearing loss and the cause is determined using pure-tone audiometry. It helps in finding out the hearing thresholds at different frequencies.

The range of pure-tone audiometers vary from simple inexpensive devices to elaborate and expensive diagnostic audiometers. In this test, a pure tone is presented to the ear through an earphone, and the lowest intensity at which the tone is perceived 50

2-Speech audiometry-

The objective of the speech audiometry is to assess the integrity of the entire auditory system by evaluating the hearing ability. Neural type of hearing loss can be identified with the help of speech audiometry. Speech audiometric test is further categorized into speech discrimination test and speech reception threshold test.

3-Suprathreshold audiometry- Recruitment is referred to the condition where patients having different degrees of hearing loss in both ears experience enhancement in perceived loudness in response to small increase in the intensity. Recruitment detection tests are known as the suprathreshold audiometry. At a typical conversational speech level, it helps detecting whether the listener can accurately recognize the speech or not. Benefits to a patient due to the use of a hearing aid can also be determined by this test

4-Self-recording audiometry- Self-recording audiometry is also referred to as Bekesy audiometry. In 1947, George von Bekesy first introduced this test. In this procedure, intensity and frequency are automatically changed with the help of a motor. The frequency can be changed in a forward or backward manner. This hearing test is performed using a recording attenuator. At a fixed rate of so many decibels per second, the attenuator can either increase or decrease the signal intensity. The attenuator action can be controlled by the listener.

5-Impedance Audiometry- The mobility and air pressure of the middle ear system and middle ear reflexes are measured in impedance audiometry.

6-Computer-administered (microprocessor) audiometry- The first commercial microprocessor audiometer was introduced in 1975. The typical microprocessor audiometer instrument contains a multifunctional keypad. Compared to the manual and self-recording audiometers, microprocessor audiometers offer significant advantages.

7-Subjective audiometry- In this test, the subjects are asked to respond when they hear the presented sound. This audiometric test can present systematically varying acoustic stimuli to the subjects and record their responses.

8-Objective audiometry- Unlike subjective audiometry, this test is not dependent on responses from the patients. However, the subjects are asked to co-operate during the attachment of the measuring electrodes or probes for carrying out the objective test.

1.3 Advantages and Disadvantages-

Advantages This test helps in measuring the softest or least audible sound which a person can hear. It provides ear specific thresholds and uses specific tones to provide place specific responses. It helps to identify the configuration of hearing loss. *Disadvantages* Audiograms obtained are very often inaccurate. It is a subjective and time consuming test.



2 Pacemaker-

A pacemaker is a small device that's placed (implanted) in the chest to help control the heartbeat. It's used to prevent the heart from beating too slowly. Implanting a pacemaker in the chest requires a surgical procedure. A pacemaker is also called a cardiac pacing device.

2.1 Types Of pacemaker

-

1. **Single chamber pacemaker**-This type usually carries electrical impulses to the right ventricle of your heart.
2. **Dual chamber pacemaker**-This type carries electrical impulses to the right ventricle and the right atrium of your heart to help control the timing of contractions between the two chambers.
3. **Biventricular pacemaker**.-Biventricular pacing, also called cardiac resynchronization therapy, is for people who have heart failure and heartbeat problems. This type of pacemaker stimulates both of the lower heart chambers (the right and left ventricles) to make the heart beat more efficiently.

2.2 Function-

Pacemakers work only when needed. If your heartbeat is too slow (bradycardia), the pacemaker sends electrical signals to your heart to correct the beat.

Some newer pacemakers also have sensors that detect body motion or breathing rate and signal the devices to increase heart rate during exercise, as needed.

A pacemaker has two parts:

1. **Pulse generator**. -This small metal container houses a battery and the electrical circuitry that controls the rate of electrical pulses sent to the heart.
2. **Leads (electrodes)**.- One to three flexible, insulated wires are each placed in one or more chambers of the heart and deliver the electrical pulses to adjust the heart rate. However, some newer pacemakers don't require leads. These devices, called leadless pacemakers, are implanted directly into the heart muscle.

2.2.1 Procedure

- Tests done before you get a pacemaker could include:

1. **Electrocardiogram (ECG or EKG)**- This quick and painless test measures the electrical activity of the heart. Sticky patches (electrodes) are placed on the chest and sometimes the arms and legs. Wires connect the

electrodes to a computer, which displays the test results. An ECG can show if the heart is beating too fast, too slow or not at all.

2. **Holter monitoring-** A Holter monitor is a small, wearable device that keeps track of the heart's rhythm. Your doctor may want you to wear a Holter monitor for 1 to 2 days. During that time, the device records all of your heartbeats. Holter monitoring is especially useful in diagnosing heartbeat problems that occur at unpredictable times. Some personal devices, such as smartwatches, offer electrocardiogram monitoring. Ask your doctor if this is an option for you.
3. **Echocardiogram.** -This noninvasive test uses sound waves to produce images of the heart's size, structure and motion.
4. **Stress test-** Some heart problems occur only during exercise. For a stress test, an electrocardiogram is taken before and immediately after walking on a treadmill or riding a stationary bike. Sometimes, a stress test is done along with echocardiography or nuclear imaging.

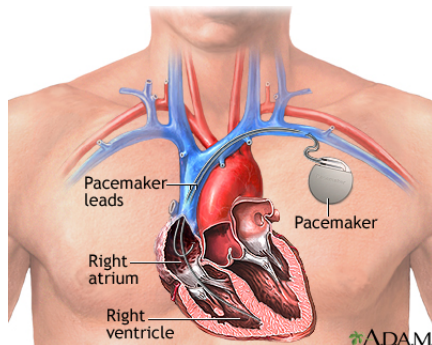
2.3 Risk And Precautions

- Risk related to pacemaker surgery or having a pacemaker are uncommon, but could include:

1. -Infection near the site in the heart where the device is implanted.
2. Swelling, bruising or bleeding at the pacemaker site, especially if you take blood thinners.
3. Blood clots (thromboembolism) near the pacemaker site.
4. Damage to blood vessels or nerves near the pacemaker.

Precaution--

1. -Keep Cellphones away
2. -Avoid certain medical test like MRI,CT Scan



3 Capsule Endoscopy

- Capsule endoscopy is a procedure that uses a tiny wireless camera to take pictures of your digestive tract. A capsule endoscopy camera sits inside a vitamin-size capsule you swallow. As the capsule travels through your digestive tract, the camera takes thousands of pictures that are transmitted to a recorder you wear on a belt around your waist. Capsule endoscopy helps doctors see inside your small intestine — an area that isn't easily reached with more-traditional endoscopy procedures. Traditional endoscopy involves passing a long, flexible tube equipped with a video camera down your throat or through your rectum.

3.1 Significance of Capsule Endoscopy

-
1. **Find the cause of gastrointestinal bleeding**-The most common reason for doing capsule endoscopy is to explore unexplained bleeding in the small intestine.
 2. Diagnose inflammatory bowel diseases, such as Crohn's disease. Capsule endoscopy can reveal areas of inflammation in the small intestine.
 3. Diagnose cancer- Capsule endoscopy can show tumors in the small intestine or other parts of the digestive tract.
 4. Capsule endoscopy is sometimes used in diagnosing and monitoring this immune reaction to eating gluten.
 5. Examine your esophagus- Capsule endoscopy has also been approved to evaluate the muscular tube that connects your mouth and your stomach (esophagus) to look for abnormal, enlarged veins (varices).
 6. Screen for polyps-People who have inherited syndromes that can cause polyps in the small intestine might occasionally undergo capsule endoscopy.
 7. Do follow-up testing after X-rays or other imaging tests. If the results of an imaging test are unclear or inconclusive, your doctor might recommend a capsule endoscopy to get more information.

3.2 Risk-

Capsule endoscopy is a safe procedure that carries few risks. However, it's possible for a capsule to become lodged in your digestive tract rather than leaving your body in a bowel movement within several days.

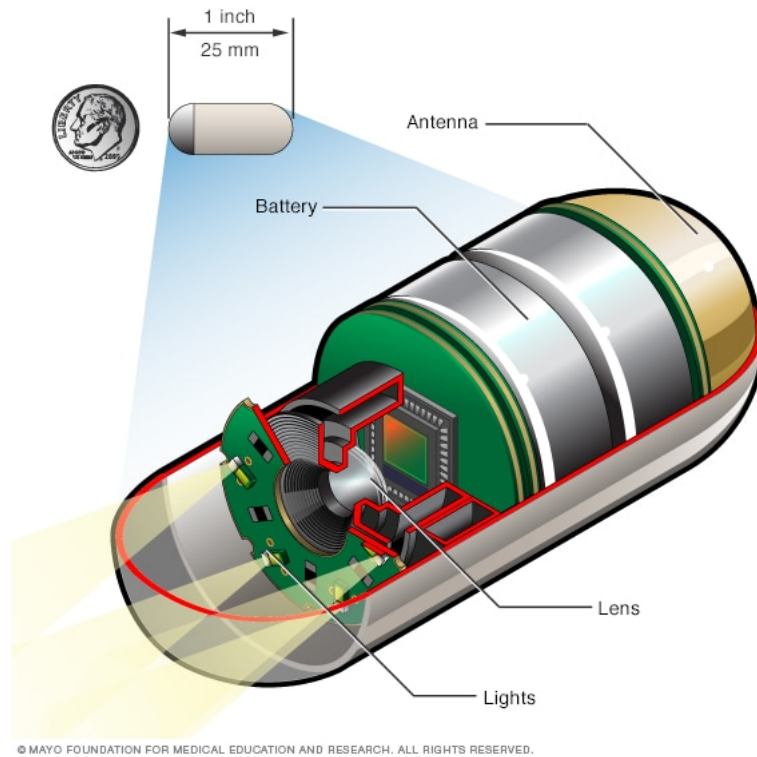
The risk, which is small, might be higher in people who have a condition — such as a tumor, Crohn's disease or previous surgery in the area — that causes a narrowing (stricture) in the digestive tract. If you have abdominal pain or are at risk of a narrowing of your intestine, your doctor likely will have you get

a CT scan to look for a narrowing before using capsule endoscopy. Even if the CT scan shows no narrowing, there's still a small chance that the capsule could get stuck.

If the capsule hasn't passed in a bowel movement but isn't causing signs and symptoms, your doctor might give the capsule more time to leave your body. However, a capsule causing signs and symptoms that indicate bowel obstruction must be removed, either by surgery or through a traditional endoscopy procedure, depending on where the capsule is stuck.

3.3 Other Information-

Capsule Therapy is costly in India around Rs.45000 in India and detect 87



4 Magnetic Resonance Imaging-

- Magnetic resonance imaging (MRI) is a medical imaging technique that uses a magnetic field and computer-generated radio waves to create detailed images of the organs and tissues in your body. Most MRI machines are large, tube-shaped magnets. When you lie inside an MRI machine, the magnetic field temporarily realigns water molecules in your body. Radio waves cause these aligned atoms to produce faint signals, which are used to create cross-sectional MRI images — like slices in a loaf of bread. The MRI machine can also produce 3D images that can be viewed from different angles

4.1 Used for Diagnosis

-
1. **MRI of the brain and spinal cord**-MRI is the most frequently used imaging test of the brain and spinal cord. It's often performed to help diagnose: Aneurysms of cerebral vessels-Disorders of the eye and inner ear, Multiple sclerosis, Spinal cord disorders, Stroke, Tumors, Brain injury from trauma.
 2. **MRI of the heart and blood vessels**-MRI that focuses on the heart or blood vessels can assess: Size and function of the heart's chambers Thickness and movement of the walls of the heart Extent of damage caused by heart attacks or heart disease Structural problems in the aorta, such as aneurysms or dissections Inflammation or blockages in the blood vessels
 3. **MRI of other internal organs**-MRI can check for tumors or other abnormalities of many organs in the body, including the following: Liver and bile ducts, Kidneys, Spleen, Uterus, Ovaries.
 4. **MRI of bones and joints**-MRI can help evaluate: Joint abnormalities caused by traumatic or repetitive injuries, such as torn cartilage or ligaments Disk abnormalities in the spine Bone infections Tumors of the bones and soft tissues
 5. **MRI of the breasts**-MRI can be used with mammography to detect breast cancer, particularly in women who have dense breast tissue or who might be at high risk of the disease.

4.2 Procedure

- Before MRI you will typically be asked to change into a gown and to remove things that might affect the magnetic imaging, such as:

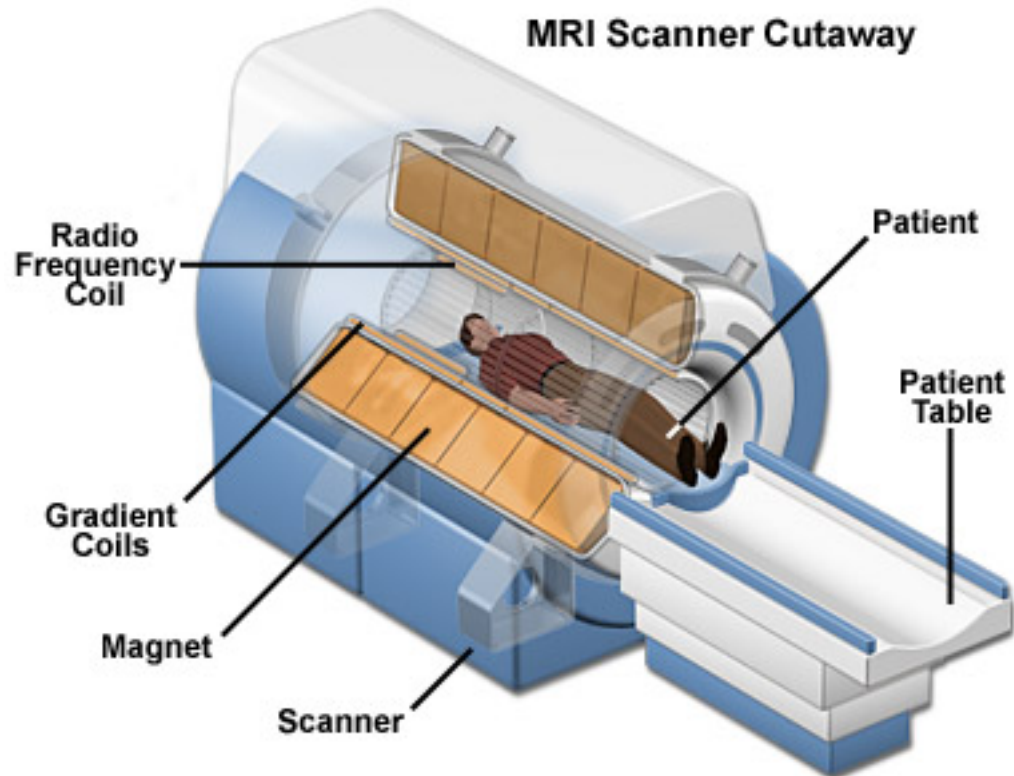
Jewelry Hairpins Eyeglasses Watches Wigs Dentures Hearing aids Underwire bras Cosmetics that contain metal particles **During the procedure-** The MRI machine looks like a long narrow tube that has both ends open. You lie down on

a movable table that slides into the opening of the tube. A technologist monitors you from another room. You can talk with the person by microphone. If you have a fear of enclosed spaces (claustrophobia), you might be given a drug to help you feel sleepy and less anxious. Most people get through the exam without difficulty.

The MRI machine creates a strong magnetic field around you, and radio waves are directed at your body. The procedure is painless. You don't feel the magnetic field or radio waves, and there are no moving parts around you. During the MRI scan, the internal part of the magnet produces repetitive tapping, thumping and other noises. You might be given earplugs or have music playing to help block the noise.

In some cases, a contrast material, typically gadolinium, will be injected through an intravenous (IV) line into a vein in your hand or arm. The contrast material enhances certain details. Gadolinium rarely causes allergic reactions. An MRI can last anywhere from 15 minutes to more than an hour. You must hold still because movement can blur the resulting images.

During a functional MRI, you might be asked to perform a number of small tasks — such as tapping your thumb against your fingers, rubbing a block of sandpaper or answering simple questions. This helps pinpoint the portions of your brain that control these actions.



5 Ultrasound

- An ultrasound is an imaging test that uses sound waves to create a picture (also known as a sonogram) of organs, tissues, and other structures inside the body. Unlike x-rays, ultrasounds don't use any radiation. An ultrasound can also show parts of the body in motion, such as a heart beating or blood flowing through blood vessels.

There are two main categories of ultrasounds: pregnancy ultrasound and diagnostic ultrasound.-

1. Pregnancy ultrasound is used to look at an unborn baby. The test can provide information about a baby's growth, development, and overall health.
2. Diagnostic ultrasound is used to view and provide information about other internal parts of the body. These include the heart, blood vessels, liver, bladder, kidneys, and female reproductive organs.

Other names: sonogram, ultrasonography, pregnancy sonography, fetal ultrasound, obstetric ultrasound, diagnostic medical sonography, diagnostic medical ultrasound

5.1 Used for Diagnosis

-

Confirm that you are pregnant.-

- Check the size and position of the unborn baby.
- Check to see you are pregnant with more than one baby.
- Estimate how long you have been pregnant. This is known as gestational age.
- Check for signs of Down syndrome, which include thickening in the back of the baby's neck.
- Check for birth defects in the brain, spinal cord, heart, or other parts of the body.

Diagnostic ultrasound may be used to:-

- Find out if blood is flowing at a normal rate and level.
- Look for blockages in the gallbladder.
- Check the thyroid gland for cancer or non-cancerous growths.
- Check for abnormalities in the abdomen and kidneys.

In women, diagnostic ultrasound may be used to:-

- Look at a breast lump to see if it might be cancer. (The test may also be used to check for breast cancer in men, though this type of cancer is far more common in women.)
- Help find the cause of pelvic pain.
- Help find the cause of abnormal menstrual bleeding.
- Help diagnose infertility or monitor infertility treatments.

5.2 Procedure

- A ultrasound usually includes the following steps:

- You will lie on a table, exposing the area that's being viewed.
- A health care provider will spread a special gel on the skin over that area.
- The provider will move a wand-like device, called a transducer, over the area.
- The device sends sound waves into your body. The waves are so high pitched that you can't hear them.
- The waves are recorded and turned into images on a monitor.
- You may be able to view the images as they are being made. This often happens during a pregnancy ultrasound, allowing you to look at your unborn baby.
- After the test is over, the provider will wipe the gel off your body.
- The test takes about 30 to 60 minutes to complete.

