

Magnetic Resonance (MR) Spectroscopy basic level

Overview

Magnetic Resonance (MR) spectroscopy is a noninvasive diagnostic test for measuring biochemical changes in the brain, especially the presence of tumors. While magnetic resonance imaging (MRI) identifies the anatomical location of a tumor, MR spectroscopy compares the chemical composition of normal brain tissue with abnormal tumor tissue. This test can also be used to detect tissue changes in stroke and epilepsy.

How does MR spectroscopy work?

MR spectroscopy is conducted on the same machine as conventional MRI (see Magnetic Resonance Imaging). The MRI scan uses a powerful magnet, radio waves, and a computer to create detailed images. Spectroscopy is a series of tests that are added to the MRI scan of your brain or spine to measure the chemical metabolism of a suspected tumor.

MR spectroscopy analyzes molecules such as hydrogen ions or protons. Proton spectroscopy is more commonly used [1, 2]. There are several different metabolites, or products of metabolism, that can be measured to differentiate between tumor types:

- Amino acids
- Lipid
- Lactate
- Alanine
- N-acetyl aspartate
- Choline
- Creatine
- Myoinositol

The frequency of these metabolites is measured in units called parts per million (ppm) and plotted on a graph as peaks of varying height (Fig. 1). By measuring each metabolite's ppm and comparing it to normal brain tissue, the neuroradiologist can determine the type of tissue present [2].

What does MR spectroscopy show?

MR spectroscopy can be used to determine tumor type and aggressiveness, and distinguish between tumor recurrence and radiation necrosis. Different metabolites can indicate:

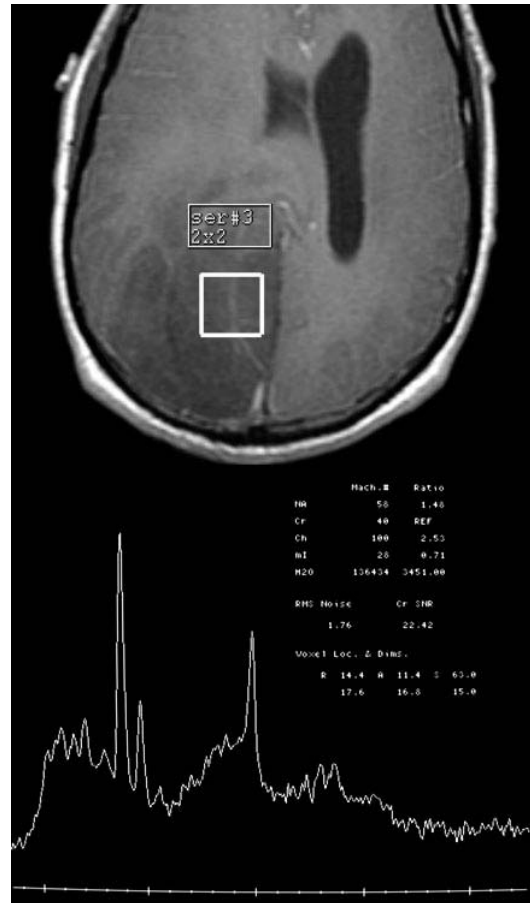


Figure 1. MR spectroscopy graph shows the different chemical peaks of a suspected brain tumor.

- Glioma: lower than normal N-acetyl aspartate levels, elevated choline and lipid levels, and lactate peaks (Fig. 1).
- Radiation necrosis: does not have elevated choline levels
- Meningioma: elevated alanine levels

Who performs the test?

A radiology technologist will perform the test in the MRI suite in a hospital's radiology department or an outpatient imaging center.

How should I prepare for the test?

- Avoid caffeinated beverages.
- Wear comfortable clothes since you will be lying still for about 30 minutes.
- Avoid wearing jewelry and metal, and remove credit cards.

What happens during the test?

You will lie on a moveable bed with your head cradled on a headrest and your arms at your sides. An antenna device called a "coil" will be placed over or around the area of the body to be imaged. It is specialized to produce the clearest picture of the area it is placed over. When you are comfortably positioned, the table will slowly move into the magnetic field. As the exam proceeds, you will hear a muffled "thumping" sound for several minutes at a time. This is the sound of the pictures being taken. You may be given an injection of contrast dye (gadolinium) into your arm or through an IV to enhance the images.

Because MR spectroscopy requires special tests on your tumor or lesion, it may take slightly longer than a conventional MRI. It is important that you relax and lie as still as possible. Any movement during this time will blur the picture.

What are the risks?

MRI and MR spectroscopy are very safe. There are no known health risks associated with the magnetic field or the radio waves used by the machine. Some people are sensitive to the contrast agent and may develop an allergic reaction. All contrast agents are FDA-approved and safe.

Some special circumstances limit the use of a magnetic field, so it's important to tell your doctor if any of the following apply to you:

- cardiac pacemaker or artificial heart valve
- metal plate, pin, or other metallic implant
- intrauterine device, such as Copper-7 IUD
- insulin pump or other infusion pump
- aneurysm clips
- previous gunshot wound
- cochlear implant or other hearing device
- employment history as a metalworker (had metal in eye)
- permanent (tattoo) eye-liner

Any metallic substance can affect the quality of the images and values obtained. The presence of metal may cause harm and/or discomfort during the test.

You should also tell your physician and/or healthcare team if you are pregnant. The American College of Radiology does not recommend MRI scanning during the first trimester of pregnancy.

While there is no definitive research indicating that MRI or MR spectroscopy should not be performed during the second and third trimesters, you will need to obtain a written order from your obstetrician for the test to be performed.

How do I get the test results?

A neuroradiologist will analyze the MR spectroscopy results. Treatment plans can be based solely on these results, so it is important that the results are as accurate as possible. The radiologist will promptly review your results and communicate directly with your referring doctor, who in turn will discuss the results with you at a later time.

Sources & links

If you have further questions about this diagnostic test, contact the doctor that ordered the test.

Sources

1. Majos, C. et al. Proton MR Spectroscopy Improves Discrimination between Tumor and Pseudotumoral Lesion in Solid Brain Masses. *American Journal of Neuroradiology* 30:544-551, 2009
2. Sanghvi, D. Recent advances in imaging of brain tumors. *Indian Journal of Cancer* 46:82-87, 2009

Glossary

contrast agent: a liquid (usually iodine or gadolinium) that is injected into your body to make certain tissues show up clearly during diagnostic imaging.

gadolinium: a type of contrast agent used during MRI.

MRI (Magnetic Resonance Imaging): a diagnostic test that uses a strong magnet to view tissues in your body and displays them in a series of "slices."

metabolite: a substance made when the body breaks down food, drugs, or its own tissue. A product of metabolism.

radiation necrosis: death of healthy tissue caused by radiation therapy; a side effect that occurs after radiation treatment has ended.

radiologist: a doctor who specializes in reading X-rays and other diagnostic scans.

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