How to prepare for your MEG
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MEG stands for “magentoencephalography”. MEG is a method for recording brain waves and figuring out what part of the brain they are coming from. You may know about electroencephalography, or “EEG”, or perhaps you have had an EEG test done. EEG is carried out by pasting metal electrodes on the scalp, and it records much of the same brain activity that MEG does by sensing the electrical currents generated by brain cells. The difference is that MEG picks up the brain activity by sensing the tiny magnetic fields that are generated when electrical currents move through the brain. Therefore, the brainwaves are detected by hundreds of tiny little coils that line the inside of a specially designed helmet. EEG, using 20-30 electrodes attached to the scalp, is also recorded simultaneously with the MEG signals.

MEG is capable of recording brain-wave activity with a higher resolution than scalp EEG for two reasons:

1) Within the special helmet are 306 magnetic sensors, more than 10 times the number of EEG electrodes ordinarily applied.

2) MEG signals are unaffected by the layers in the head that they must pass through in order to reach the outside surface. EEG signals are markedly distorted, reduced, and smeared out by the layers of fluid, skull, and scalp that separate the brain activity from the surface. Not so for MEG signals.

Because of these two advantages, it is possible to more accurately locate the precise location of any activity recorded during the MEG test. This improved “source localization” is especially important in the case of abnormal brain wave activities --- such as those that occur in patients with epilepsy --- because we do not know in advance where these abnormal discharges arise from.

Like EEG, MEG can record both normal and abnormal brain signals. You will lie comfortably on a bed for about an hour while we record the MEG signals from your brain. If there are any abnormal signals that occur during the MEG recording, the processing that is done during the analysis phase after you leave the MEG lab will be able to identify what part of the brain is responsible for creating those abnormal signals. It is often useful to record the brain’s MEG response to normal tasks, such as listening to sounds or words, viewing items or patterns on a screen, feeling a sensation in your arms or legs. That way the part of your brain that helps you normally perceive your environment can be identified and compared with any parts of your brain that are not functioning normally.

The MEG examination is carried out in a shielded room in order to prevent outside interference from contaminating the measurement of your brain’s MEG signal. Inside the room, the MEG machine consists of a special magnetic listening device which can measure you either lying down (as shown in figure 1) or in a chair. The device emits no energy of any kind ---no magnetic fields, no x-rays, no radiation, no electricity. You simply lie down, position your head
into the MEG helmet (which is an upside-down bowl sort of like the large hair-dryers they have at salons), and try to stay as still as you can. That is all there is to it; most patients find it so peaceful that they fall asleep.

Figure 1. Patient reclining on a special non-magnetic bed with his head positioned in the helmet that records brain magnetic signals. Photo taken through the door at the entry to the MEG shielded room.

In preparation for the MEG, we first attach a number of EEG and other tiny sensors to your head in exactly the manner that EEG electrodes are attached. Next we measure your head and the position of several of the attached sensors with a kind of computerized magic wand, as illustrated in figure 2. Before you go into the shielded room, we make sure that you do not have any magnetization on or in your body so that only the brain’s magnetic field will be measured. Therefore, any metallic items, such as jewelry, clothing with snaps or buckles, bras with metal wires, eyeglasses, etc will have to be removed.

Figure 2. Subject seated in chair, while technologist measures various points on his head with a special magic wand. So that the magic wand will work properly, the patient must temporarily wear a special pair of glasses. These glasses are taken off before entering the magnetically shielded room.
While you are in the shielded room alone (or with a parent/caregiver for those who need some reassurance or comforting), we will be in constant communication with you by intercom. And, as shown in figure 3, we can see you on a TV monitor at all times. We constantly check your position in the MEG machine (i.e. how far into the upside-down bowl you are) to insure that we are getting a good recording. Most patients simply remain still and end up drifting off to sleep during the quiet part of the recording. For many patients, there will also be a short active part of the recording where you will be asked to listen to earphones or feel a stimulus.

At the conclusion of the recording, you will come out of the shielded room and change back into your regular clothes. We will remove the extra sensors that were attached to your head, and you are all finished!

Figure 3  Doctors and technologists are constantly monitoring your brain magnetic activity during the recording, while at the same time keeping tabs on your comfort by watching the TV monitor (the right-most screen above).

Figure 4. After your recording has been completed, doctors analyze the results using specialized computer systems that help locate the origin of the MEG signals inside the head.
After you leave the MEG laboratory, there will be many hours spent analyzing your MEG recordings (depicted in figure 4). For epilepsy patients, the results can be used to guide surgery --- either by indicating the location of abnormal brain tissue that should be removed in order to eliminate seizures (an actual example is shown in figure 5), or by suggesting the locations inside your head where intracranial electrodes (such as “subdural grids” or “SEEG electrodes”) would be best positioned to record important information. For patients with other disorders, the MEG may be used to pinpoint the location of important normal functions in order to tell the surgeon where NOT to remove brain tissue.

Figure 5. The results of your MEG scan are merged with the rest of your imaging results (usually with your MRI as shown above) to accurately determine precisely where the recorded signals are coming from. These pictures, along with explanatory text, are conveyed to your doctor as soon as the report is completed, usually in about two weeks.

If you have any questions or concerns about your upcoming MEG exam, please feel free to ask your nurse or your doctor. We will, of course, explain everything to you when you arrive and throughout the test.