Anesthesia in the MRI Unit

Overview

The Department of Radiology has a state-of-the-art magnetic resonance imaging (MRI) machine which can make finely detailed images of any part of the body without the use of ionizing radiation. To produce the images, the machine employs a very strong, static magnetic field (>20,000 times the strength of the earth’s magnetic field) in conjunction with a time-varying magnetic field and a third magnetic field, pulsed at radio frequency. These fields are believed to be harmless to patients and staff (except possibly pregnant women). However, the steady field poses a hazard because loose ferromagnetic objects inadvertently brought into the MRI room can become projectiles and cause serious injury, and because ferromagnetic metallic objects within the bore of the magnet will be heated due to electrical currents induced in them by the time varying fields and may cause burns.

Occasionally anesthesia services will be requested for patients undergoing MRI imaging. As the procedure is not painful, anesthesia may be needed for the sole purpose of rendering the patient immobile during scans, which may last from approximately two to twenty minutes each. The total time spent in the MRI unit is typically on order of one hour. Both for reasons of safety and to prevent degradation of the image, use of many pieces of ordinary equipment used to administer general anesthesia and monitor the patient’s vital functions is contraindicated in the MRI facility.

Guidelines for Anesthesia Personnel

- Use of general anesthesia in the MRI facility should be confined to young children, mentally incompetent adults, patients with movement disorders, and those who cannot tolerate being in the scanner due to pain. The limited accessibility to the patient while in the machine and the difficulty with monitoring make general anesthesia significantly more hazardous in the MRI room than in the operating room.

- Children and adults with phobias may be able to be managed with light sedation administered by the nursing staff of the Department of Radiology. Careful judgment is required in the selection of patients for light sedation, as a single movement will ruin an expensive scan, and difficulties with one patient may disrupt the entire day’s schedule. If heavy sedation is required, monitored anesthesia care will be requested.

- Outpatients who may require sedation or anesthesia for MRI will be seen in advance by the nursing staff of the Department of Radiology. Appropriate medical records, including history & physical exam, recent labs, and possibly electrocardiogram and x-ray reports will be obtained from the referring facility. If it is determined that monitored anesthesia care or general anesthesia will be needed, the patient will then be referred to the pre anesthesia clinic for evaluation, and the case will be scheduled through the operating room scheduling desk.
To assure the availability of anesthesia personnel for these cases, scheduling is done through the operative room and coordinated with the surgical schedule. Since the presence of an attending anesthesiologist may be required in the scanner room, the anesthesia staffing schedule should be arranged so as not to have that attending simultaneously committed to supervise other anesthetics if possible.

Scanner time is very expensive and is tightly booked. Therefore, the anesthesia personnel should make every effort to be set-up on time and to expedite the procedure.

**Suggestions Regarding Equipment**

- Anesthesia personnel should remove all ferrous metal from their person. This includes metallic stethoscopes, safety pins to hold ear-pieces, wallets containing credit cards, ID badges, metal-encased ball point pens, hair pins, scissors, beepers, and mechanical wrist watches. **Beware! Any credit cards brought into close proximity to the magnet are “wiped clean”**. Digital wristwatches, eyeglasses, and the metal fasteners on scrub suits and undergarments pose no problem. A portable magnet is kept in the control room to test questionable objects.

- Piped-in oxygen, suction, a non magnetic back-up oxygen tank, and an isoflurane vaporizer are available in the scanner room and should be checked-out. Be certain that the vaporizer has not been jostled or tipped, as this will cause it to give massive anesthetic overdoses for some time afterwards.

- An anesthesia cart with an electrocardiograph monitor, blood pressure monitor, carbon dioxide detector, and pulse oximeter should be set-up in the examining room opposite the entrance to the scanner. An anesthesia machine will usually be set up, although it is often not needed.

- The scanner room's breathing apparatus should have long oxygen-supply tubing and long tubing for scavenging the waste anesthetic gasses. For adults and larger children, an all-plastic Bains circuit is available with long corrugated tubing connected to the breathing bag. For children weighing less than approximately 10 kg, the Respiratory Therapy Department has available a special non-magnetic ventilating apparatus with a pop-off valve.

- The intravenous infusion should also have long connecting tubing. If deemed necessary, an infusion pump can be used (see Pope KS. Anesth Analg 77(3): 645, 1993).

- Standard endotracheal tubes should be used, although the spring in the valve for the pilot balloon can cause image artifacts and may need to be repositioned for neck scanning (see Brenn BR & Saldutti G. Anesth Analg 79(3): 586-7, 1994). A plastic diagnostic stethoscope and plastic esophageal stethoscope with a long connecting tubing and no temperature sensor are available and may be used.

- A crash cart is available in the radiology suite. Under no circumstances should one attempt a major resuscitation in the scanner room. In an emergency, the stretcher used for scanning can be detached from the machine and moved across the hall, where the anesthesia equipment is kept.

- Conventional electrocardiograph monitors and the Dinamap will not work in the scanner room. The scanner room has a built-in electrocardiograph monitor whose display is located in the control room, where it can be turned and viewed through the window. During scanning, one can recognize QRS complexes, but little else on the tracing. Be sure that the wires to the electrodes run a straight path, without loops, out of the bore of the magnet. Have a blanket as heat insulation between the wires and the patient's skin. The Datascope noninvasive blood pressure monitor will work with a long extension tubing to the cuff.
Conventional pulse oximeters will work, but can cause severe burns under the sensor. A special fiberoptic pulse oximeter is available and should be used. The pulse oximeter, capnometer, and noninvasive blood pressure monitor are kept on a cart that should be at the far end of the room, along the axis of the magnet.

Patients should be carefully screened by history and physical examination for the presence of cardiac pacemakers, metal implants, shrapnel (especially in the eye), or other foreign bodies that may pose a threat to them or may degrade the image. Inform the radiologist or MRI technologist about any foreign bodies in the patient and obtain their clearance before taking the patient into the magnet room. Patients should wear a hospital gown and nothing else (they can be covered with blankets for warmth). Eye makeup, dentures, and wigs should be removed. Patients should wear earplugs as protection from noise, even though they will be anesthetized, and the anesthesia personnel should also.

Anesthesia should be induced with the patient positioned on the special MRI stretcher for transport into the scanner. The endotracheal tube should be well secured, as patient’s head will be inaccessible once positioned in the scanner.

Hypodermic needles are non-ferromagnetic, so that drugs may be brought into the magnet room at will. Do not bring in a conventional clipboard or laryngoscope.

As many people as necessary can stay in the scanner during a run. However, no one can enter or leave during scanning. An intercom and window provide for communication with the operator.

Patients will recover in the regular recovery room upon completion of the procedure.

**Set Up and Equipment for Cases in MRI (SW213)**

**Preop Preparation**

**Inform anesthesia tech to take...**

- Anesthesia cart
- Extension tubing
- Jackson-Reese (optional) – alternately can use ambu bag or MRI-compatible anesthesia machine
- Twitch monitor

**Also need...**

- IV bag and tubing
- Stethoscope

**In holding area outside MRI scanner...**

- Set up suction (usually not ready).
- Set up anesthesia cart for intubation in holding room just outside MRI room.
- Set up Jackson-Reese for ease of movement to MRI room and back (optional).
- Set up anesthesia machine provided by MRI department and stored in the MRI room (anesthesia tech to assist).
ANESTHESIA IN THE MRI UNIT

Meeting the Patient...

- Assure written anesthesia consent form is filled out and signed.
- Assure patient will fit in MRI Scanner (caution with obese patients).
- If MRI of the head, assure patient's head fits into the head harness that will be used (this is a problem with obese patients with large heads).

Anesthesia Induction

1) Capnograph monitoring can be done with the portable machine that follows the patient into the MRI room. Alternately, use the colorimetric device.

2) Induce and intubate in the holding area.

3) Transfer the patient to MRI room and bed.

MRI Scanner

- Do a dry run of movement the bed is going to make, assuring IV tubing and anesthesia tubing have enough slack to allow patient in and out of MRI Machine.
- If you choose to monitor the patient from the control room, the camera on the patient is not detailed enough to see if anesthesia tubing or IV tubing is getting pulled out, or to see a chest rise and fall with breathing.
- If an MRI of the head, there is almost no view of the face. Be sure the endotracheal tube is well secured and not kinked.
- In the control room, you will have a wireless monitor that controls the BP cuff, ECG, pulse-ox, and capnograph monitoring.
- Because of the above concerns, pediatric or unstable patients should be monitored by you in the scanner, not the control room.

References

General References


Safety


Equipment Issues


Anesthesia


**Sedation**


**Contrast Agents**

