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Pregnant Patients and MRI Procedures

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Magnetic resonance (MR) imaging has been used to evaluate obstetrical, placental, and fetal abnormalities in pregnant patients for more than 25 years. MR imaging is recognized as a beneficial diagnostic tool and is utilized to assess a wide range of diseases and conditions that affect the pregnant patient as well as the fetus.

Initially, there were substantial technical problems with the use of MR imaging primarily due to image degradation from fetal motion. However, several technological improvements, including the development of high-performance gradient systems and rapid pulse sequences, have provided major advances especially useful for imaging pregnant patients. Thus, MR imaging examinations for obstetrical and fetal applications may now be accomplished routinely in the clinical setting.

PREGNANCY AND MRI SAFETY

The use of diagnostic imaging is often required in pregnant patients. Thus, it is not surprising, that the question of whether or not a patient should undergo an MR examination during pregnancy will often arise. Unfortunately, there have been few studies directed toward determining the relative safety of using MR procedures in pregnant patients. Safety issues include possible bioeffects of the static magnetic field of the MR system, risks associated with exposure to the gradient magnetic fields, the potential adverse effects of radiofrequency (RF) energy, and possible adverse effects related to the combination of these three electromagnetic fields.

MR environment-related risks are difficult to assess for pregnant patients due to the number of possible permutations of the various factors that are present in this setting (e.g., differences in field strengths, pulse sequences, exposure times, etc.). This becomes even more complicated since new hardware and software is developed for MR systems on an on-going basis.

There have been a number of laboratory and clinical investigations conducted to determine the effects of using MR imaging during pregnancy. Most of the laboratory studies showed no evidence of injury or harm to the fetus, while a few studies reported adverse outcomes for laboratory animals. However, whether or not these findings can be extrapolated to human subjects is debatable.

By comparison, there have been relatively few studies performed in pregnant human subjects exposed to MR imaging or the MR environment. Each investigation reported no adverse outcomes for the subjects. For example, Baker et al. reported no demonstrable increase in disease, disability, or hearing loss in 20 children examined in utero using echo-planar MRI for suspected fetal compromise. Myers et al. reported no significant reduction in fetal growth vs. matched controls in 74 volunteer subjects exposed in utero to echo-planar MRI performed at 0.5-Tesla. A survey of reproductive health among 280 pregnant MR healthcare professionals performed by Kanal et al. showed no substantial increase in common adverse reproductive outcomes.

There has been on-going concern that acoustic noise associated with MRI may impact the fetus. Reeves et al. (2010) conducted an investigation to establish whether fetal exposure to the operating noise of 1.5-T MR imaging causes cochlear injury and subsequent hearing loss in neonates. The findings in this study provide some evidence that exposure of the fetus to 1.5-T MR imaging during the second and third trimesters is not associated with an increased risk of substantial neonatal hearing impairment.

With regard to the publications to date, there are discrepancies with respect to the experimental findings of the effects of electromagnetic fields used for MR procedures and the pertinent safety aspects of pregnancy. These discrepancies may be explained by a variety of factors, including the differences in the scientific methodology used, the type of organism

examined, and the variance in exposure duration, as well as the conditions of the exposure to the electromagnetic fields. Additional investigations are warranted before the risks associated with exposure to MR procedures can be absolutely known and properly characterized.

GUIDELINES FOR THE USE OF MR PROCEDURES IN PREGNANT PATIENTS

As stated in the Policies, Guidelines, and Recommendations for MR Imaging Safety and Patient Management issued by the Safety Committee of the Society for Magnetic Resonance Imaging in 1991, "MR imaging may be used in pregnant women if other nonionizing forms of diagnostic imaging are inadequate or if the examination provides important information that would otherwise require exposure to ionizing radiation (e.g., fluoroscopy, CT, etc.). Pregnant patients should be informed that, to date, there has been no indication that the use of clinical MR imaging during pregnancy has produced deleterious effects."

This policy has been adopted by the American College of Radiology and is considered to be the "standard of care" with respect to the use of MR procedures in pregnant patients. Importantly, this information applies to MR systems operating up to and including 3-Tesla.

Thus, MR procedures may be used in pregnant patients to address important clinical problems or to manage potential complications for the patient or fetus. The overall decision to utilize an MR procedure in a pregnant patient involves answering a series of important questions including, the following:

- Is sonography satisfactory for diagnosis?
- Is the MR procedure appropriate to address the clinical question?
- Is obstetrical intervention prior to the MR procedure a possibility? That is, is termination of pregnancy a consideration? Is early delivery a consideration?

With regard to the use of MR procedures in pregnant patients, this diagnostic technique should not be withheld for the following cases:

- Patients with active brain or spine signs and symptoms requiring imaging.
- Patients with cancer requiring imaging.
- Patients with chest, abdomen, and pelvic signs and symptoms of active disease when sonography is non-diagnostic.
- In specific cases of suspected fetal anomaly or complex fetal disorder.

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