

Fetal Imaging Through the Use of MRI

When a person thinks of fetal imaging, the first thing that usually comes to mind is ultrasound. The question is why is that the case? Certainly ultrasound has been used more, is more cost efficient, and is more common, but why not use other modalities? There are other alternatives. In fact, some researchers would even argue that there are better alternatives. While the use of magnetic resonance imaging (MRI) in the field of fetal imaging is not the most common, it is certainly not unheard of. Doctors have been using MRI for the imaging of fetuses for years. It is increasingly important for expectant parents as well as their physicians to know that they have other options for diagnosing any possible complications that may arise with their child throughout the term of their pregnancy.

“Magnetic resonance imaging (MRI) is a non-invasive way to take pictures of the body” (7). An uneducated person will often include MRI in the same category with radiography (most commonly referred to as x-rays) and computed tomography (CT) scans which can be quite misleading, especially when it comes to the safety issue of the fetus. Radiography and computed tomography scans use ionizing radiation to produce images for diagnoses while “MRI uses a strong magnetic field and radio waves along with a computer to generate sectional images of patient anatomy” (1). MRI is used for a variety of different diagnostic

purposes on people at all stages of life including pregnant women and their fetuses. “Technological advancements have made it possible to produce detailed magnetic resonance imaging (MRI) images of a fetus in the womb, a fact that is making MRI an increasingly important clinical tool for diagnosing fetal abnormalities and understanding normal fetal development” (8).

“Since the development of fast imaging techniques, magnetic resonance imaging (MRI) has been used to evaluate fetal anomalies. MR fetal imaging has become an important adjunct to ultrasound in the evaluation of fetal anomalies” (2). Fetal imaging through MRI is becoming more common in hospitals and clinics worldwide. Many physicians and their staff are now using this technology in ways that they never before thought possible. “Magnetic resonance imaging techniques can provide real-time measurements of volume in a fetal heart, and may better enable physicians to plan care for infants with heart defects. By producing three-dimensional measurements, functional MRIs may represent an advance over the current technology, fetal echocardiography” (6). Magnetic resonance imaging can produce actual computer generated three-dimensional images which gives it an advantage over echocardiography which must rely on the physician to assume how big the heart is in the fetus. The volume of the heart's ventricles can also be measured more effectively with the use of MRI as

opposed to echocardiography. “Echocardiography, which uses reflected ultrasound waves to produce images, may allow physicians to estimate such volumes, but only if the heart has a normal shape. Many heart diseases involve abnormal shapes, and accurately measuring ventricular volume in such cases is important in assessing how well the heart is working and in guiding doctors to the most appropriate treatment” (6). By having a better knowledge of both the structure and function of the fetus’s heart, the physician and parents will have a better way to plan for possible surgery on the infant after birth as well as how to handle any possible difficulties that may arise with the delivery.

Diagnosing fetal anomalies can be difficult with the use of ultrasound alone. There are often many limitations that prohibit a physician from seeing what needs to be seen for proper diagnoses. “There are certain things that can’t be done effectively with ultrasound, such as obtaining a picture of the whole fetus or clearly delineating CNS defects” (5). “Ultrasound provides a small field-of-view, and the resolution of ultrasound images is restricted by penetration through soft tissues and bone. Thus, the sensitivity of ultrasound in evaluating the fetus is reduced in obese patients and in women whose pregnancies are complicated by low amniotic fluid volume” (2). Ultrasound quality can also be influenced by fetal position within the womb. “A prone, breech fetus may be

much more difficult to examine than a vertex supine fetus. If the head is low in the maternal pelvis, it may also be difficult to assess using ultrasound” (2).

Shadowing from bone may also prohibit many images from being seen well with the use of ultrasound alone. “When imaging the fetal brain, it is hard to get sound waves through the skull because it is ossified. You cannot visualize the brain parenchyma. Similarly, with the fetal chest, the ribs can cause shadowing or the spine can be in the way, so it can be difficult to see the entire lung. With MRI, you can see it without a problem. You get direct visualization of the entire structure in question” (5). These are complications that do not inhibit the use of MRI for fetal imaging. In fact “reduced amniotic fluid volume may actually improve MRI by limiting any fetal motion” (3). “We use MRI as a problem-solving tool, when ultrasound is saying something to us but we don’t quite know what it is or what it means, says Damien Grattan-Smith, MD, medical director of radiology for Children’s Health Care in Atlanta, where fetal MRI has been used for the past 18 months” (5).

As with any procedure, safety is an extremely large concern both for the patient and the physician. As a parent, the question of safety is often the only question that matters. One of the reasons that ultrasound is so frequently used is because it is known to be a safe way to take images of a fetus. “Given its long

record of safety, utility, and cost-effectiveness, ultrasound will remain the modality of first choice when screening the fetus” (5). That does not mean, however, that ultrasound is the only safe option for fetal imaging. So, is it safe for a pregnant patient to have an MRI? Are there risks to the fetus? Studies have shown no negative or harmful side effects to using MRI when imaging the fetus. “Since ionizing radiation is not involved, MRI is a valuable tool for diagnosing pregnant women and studies have yet to report any adverse effects to the mother or fetus. Further, risk for any delayed sequelae is extremely small or nonexistent” (5). Research has shown that there are no immediate or short-term effects to using MRI, and studies are currently underway to determine the same for any long-term or lasting effects.

MRI has been proven to be more helpful and beneficial in diagnosing certain illnesses in fetuses that ultrasound either was unable to see or misdiagnosed altogether. Physicians “can see a lot more abnormalities, and can see that the type of information that MRI provides can change patient management and neonatal care” (5). “Fetal MRI is a powerful screening tool for fetal brain anomalies, said principal investigator Sahar Saleem, MD, PhD. It provided a measure of confidence and additional information that confirmed or changed the prenatal ultrasound diagnoses of pregnancies with high risk for

brain anomalies" (4). MRI has the ability to not only make diagnoses or confirm diagnoses made by ultrasound; it can in fact completely alter the diagnoses previously made. "MRI changed the ultrasound diagnosis in 26 of 66 (40%) cases of CNS (central nervous system) anomalies and changed patient counseling in 33 of 66 (55%). The same study found that 24 of 52 (46%) fetuses with CNS abnormalities were managed differently after the MRI studies were performed. This report echoes the conclusions of the others that MRI is an effective adjunct to ultrasound in the evaluation of CNS anomalies and is particularly useful in providing additional information and allowing more definitive diagnoses than can be provided by ultrasound alone" (2). A similar study "reported 18 fetal chest masses diagnosed by ultrasound in which the subsequent prenatal MRI changed the diagnosis in 9 cases (50%)" (2). MRI is not likely to take the place of ultrasound, but it can and has been proven to work well as an adjunct to coming up with the best possible diagnoses during fetal imaging.

Technology is constantly advancing, and although the use of MRI has grown exponentially in the last few decades, the use for fetal imaging with MRI has been slow to keep pace. Without this technology some patients will continue to be misdiagnosed and suffer at the hands of physicians who are afraid of using all of the technologies that are available. Patients will continue to be

left wondering if there was any other way that they could have gotten a more definitive diagnosis. The ones that benefit from this non-confined mindset of taking advantage of using this modality are the parents and their new children. I understand the hesitation that some physicians and parents have when determining whether or not to use MRI as a tool for fetal imaging without knowing about any possible long-term side effects; however, insufficient efforts are being taken in the way of making strides directed at changing this fact. Several researchers are working diligently in this field, but not enough and not quickly enough when compared with the obvious need based on the results that have been shown thus far.

References

1. Adler, Arlene M. and Richard R. Carlton, Introduction to Radiologic Sciences And Patient Care, 4th ed. St. Louis: Elsevier Saunders, 2007.
2. Brown, Stephen D., Judy A. Estroff, and Carol E. Barnewolt. "Fetal MRI." Applied Radiology 33.2 (2004): 9-25. 22 Sept. 2008.
http://www.medscape.com/viewarticle/470837_1
3. Glastonbury, Christine M, and Anne M Kennedy. "Ultrafast MRI of the fetus." Australasian Radiology 46.1 (2002): 22-32. MEDLINE. EBSCO. 2 Sep. 2008.
<http://web.ebscohost.com/ehost/pdf?vid=2&hid=17&sid=6e3bffa4-4ac4-43a9-b15e-2b18a880dd0c%40SRCSM2>
4. Gough, Camila. "Fetal MRI: A Powerful Screening Tool for Fetal Brain Anomalies." MedicExchange. 28 Nov. 2007. 1 Sept. 2008
<http://www.medicexchange.com/Neuro/news.aspx/12090/-Fetal-MRI--a-powerful-screening-tool-for-fetal-brain-anomalies>

5. Harvey, Dan. "Fetal MRI: Seeing What Ultrasound Doesn't." Radiology Today.
6.2 (24 Jan. 2005): 18. 1 Sept. 2008.
http://www.radiologytoday.net/archive/rt_012405p18.shtml

6. McCool, Joey Marie. "Real-time MRI Helps Doctors Assess Beating Heart in Fetus." EurekAlert. 29 Sept. 2005. CHOP. 1 Sept. 2008.
http://www.eurekalert.org/pub_releases/2005-09/chop-rmh092905.php

7. UCSF Children's Hospital. Medical Tests-MRI. 31 Oct. 2006. U of California, San Francisco. 21 Sept. 2008.
<https://www.ucsfhealth.org/childrens/adam/data/003335.html>

8. Vaughan, Christopher. "MRI Provides Insights into Fetal Brain." UCSF Today.
2 Feb. 2007. U of California, San Francisco. 21 Sept. 2008.
<http://pub.ucsf.edu/today/cache/feature/200702013.html>