INTRODUCTION

- MR works well in the fetus due to the high water content of fetal tissue and pathology.

- Fetal MRI is a proven and established imaging modality for evaluating fetal anomalies not well seen by ultrasound.
- Fetal MRI is now considered a "subspecialty" of Pediatric Radiology.
- Those interpreting fetal MRI’s should be familiar with fetal pathology as it can be different from newborns, children and adults.
INTRODUCTION

• Ultrasonography remains the method of choice for evaluating the fetus.

• MRI however can complement US and can improve accuracy of diagnosing certain fetal abnormalities which can in turn alter patient counseling and planning.
  – MRI however can be misleading if not closely correlated with the clinical history and sonographic findings.

  ACR-SPR Practice Guidelines 2010

SAFETY

• Is fetal MRI safe?
  – Several studies have failed to demonstrate adverse long-term effects of fetal MRI, but the sample sizes have been small.

• Research has failed to show any reproducible harmful effects on 3T or weaker magnetic fields used in routine clinical MR imaging.
  – However far less is known about potential effects of the time varying gradient and/or radiofrequency magnetic fields.


• "The principal theoretical risk of fetal MR relates to excess tissue heating, which has been associated with growth retardation and congenital malformations in various animal models."

SPR Website.

• “Similar malformations have been observed in children born to women who experienced significant hyperthermia in the first trimester of pregnancy.”

SPR Website.
SAFETY

• “Numerous reports in the biological physics literature have addressed the theoretical risks of tissue heating related to exposure to the radio-frequency electromagnetic fields that are generated by MR.”

SPR Website.

SAFETY

• “Guidelines for the general public do exist for maximum exposure limits for the rate at which energy is absorbed by the body when exposed to RF electromagnetic fields (as measured by the Specific Absorption Rate – SAR).”

SPR Website.

SAFETY

• Safe limits have also been suggested for maternal and fetal body temperature. Biological physicists studying the effects of MR have noted in experimental models that meeting exposure limits for the pregnant woman may not protect the fetus from overexposure, and that the safety of the fetus may be overestimated in numerous models.”

• Further work is however needed.

SPR Website.
SAFETY

• NO CONTRAST
  – There are no fetal indications for the use of MRI contrast.
  – Risk to fetus remains unknown and may be harmful.
  – Gadolinium is a pregnancy class C drug.
    • Safety in humans has not been proven.


SAFETY

• Gadolinium based-MR contrast agents
  – Cross the placental barrier and enter the fetal circulation.
  – From there, they are filtered by the fetal kidneys & excreted into the amniotic fluid.
  – Gadolinium-chelate molecules may remain in amniotic fluid for indeterminate amount of time.


SAFETY

• Gadolinium based-MR contrast agents
  – The longer gadolinium-chelate molecules stay in the amniotic fluid, the greater the chance for dissociation of the potentially toxic gadolinium ion from its chelate molecule.

SAFETY

• "Pregnant patients can be accepted to undergo MR scans at any stage of pregnancy if, in the determination of a level 2 MR personnel-designated attending radiologist, the risk-benefit ratio to the patient warrants that the study be performed."


SAFETY

• Level 2 MR Personnel
  – "Individuals who have been more extensively trained and educated in the broader aspects of MR safety issues, including issues related to the potential for thermal loading or burns and direct neuromuscular excitation from rapidly changing gradients, will be referred to as level 2 MR personnel (e.g., MRI technologists, radiologists, and radiology department nursing staff)."

ACR guidance document for safe MR practices 2007

TECHNIQUE

• 1.5T MRI with a torso coil.
• Noncontrast.
• 3-5 mm thickness
TECHNIQUE

• Sequences
  – Single shot fast spin echo sequences
  – MR Fetography
  – T1 weighted

TECHNIQUE

• Performed in the fetal sagittal, coronal and axial planes.

PATIENT SELECTION

• Fetuses with known or suspected abnormalities.
PATIENT SELECTION

• Gestational age greater than 17 weeks.
  – The ACR recommends that fetal MR be deferred until after 20 weeks.
  • In part because the fetus is so small at earlier gestational ages that MR is unlikely to add much additional information to ultrasound.
  • Effects of energy deposition on developing structures are not completely understood.
  • Concern for the developing auditory apparatus in particular.

WHY DO A MRI

• An abnormality on US is not clearly defined & more information is sought in order to make a decision about therapy, delivery, or to advise a family about prognosis.
  – Example: Potential anomaly in the setting of maternal obesity, oligohydramnios, or advanced gestational age.

WHY DO A MRI?

• An abnormality is identified on US and the treating physician desires MR-specific information in order to make decisions about care.
  – Example might include the calculation of MR-derived fetal lung volumes in cases of congenital diaphragmatic hernia.
WHY DO A MRI?

• A fetus is significantly at risk for abnormality that will affect prognosis even if no finding is discovered with ultrasound.

COMMON INDICATIONS

• Evaluation of:
  – Central nervous system (CNS)
    • Brain/Head & Neck
      – Structural abnormalities
COMMON INDICATIONS

• Evaluation of:
  – Central nervous system (CNS)
    • Spine
      – Structural abnormalities

COMMON INDICATIONS

• Evaluation of:
  – Chest lesion
    • Congenital Diaphragmatic Hernia
    • CCAM/CPAM/Sequestration

COMMON INDICATIONS

• Evaluation of:
  – Genitourinary (GU)
    • Renal abnormalities
    • Bladder outlet obstruction/posterior urethral valves
COMMON INDICATIONS

- Evaluation of:
  - Abdominal Wall Defects
    - Omphalocele
    - Gastrochisis-sometimes

COMMON INDICATIONS

- Evaluation of:
  - Twin Pregnancy
    - Twin-Twin transfusion
    - Conjoined
  - Fetal surgery

COMMON INDICATIONS

- Evaluation of:
  - Placental abnormalities
    - Placenta accreta
    - Placenta increta
    - Placenta percreta
INTERESTING CASES

CASE 1
Ultrasound demonstrated ventriculomegaly

CASE 1

CASE 1
Mitochondrial disorder resulting in fatal infantile lactic acidosis

CASE 2
Ultrasound demonstrated a cleft lip and ventriculomegaly

CASE 3
Ultrasound demonstrated cardiac lesions
CASE 3

Ultrasound demonstrated size greater than dates by almost four weeks, lateral ventriculomegaly and macrocephaly (>98th percentile for gestational age) at 35 weeks. MRI at 36 weeks.

Tuberous Sclerosis

CASE 4

Ultrasound demonstrated size greater than dates by almost four weeks, lateral ventriculomegaly and macrocephaly (>98th percentile for gestational age) at 35 weeks. MRI at 36 weeks.
Proteus Syndrome

CASE 5
Ultrasound showed a mass arising from the face consistent with a hemangioma.

MRI at 30 weeks  MRI at 34 weeks

CASE 4
Grade III Rhabdoid tumor