Fetal MRI in practice

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Introduction

- **US**: primary screening modality, low cost, real time capability
- **MRI**: complementary imaging method informative when US is inadequate and doubtful, in 2d & 3d trimester
- To have a high-quality sonogram performed before the MRI is still important
MRI advantages

- MRI uses no ionizing, provides a large field of view, has excellent soft-tissue contrast resolution, allows multiplanar views
- MRI is not limited by overlying bone, fetal position, maternal obesity
- MRI permits tissular characterisation (blood, fluid, meconium)
MRI Limits

- Absolute contraindications: claustrophobic patient, ferromagnetic cerebral aneurysm clip, pace-maker.
- Artefacts due to fetal motion, severe oligohydramnios
- Avoided in the 1st trimester; No known biologic risks, but « principe de précaution » & FDA recommends patient’s information
MRI Applications

• Applications increase with ultrafast imaging technique
• Latest generation of MRI devices: thin slices
• Fetal anatomy: CNS, Face, Thorax (lung volumetry), abdomen abnormalities (urinary and gastrointestinal tracts), tumoral extension.
• Others:
  – placenta praevia: both US & MRI have similar abilities (Dwyer B, Stanford 2006)
  – pregnant patient with associated pathology (acute abdomen, hydronephrosis, adnexial masses…)
  – pelvimetry
Procedure

- Patient information, maternal sedation (flunitrazepam 0.5 à1 mg ) when polyhydramnios , < 30 GWeeks.
- 1.5 T superconducting system
- Pregnant women : supine or partial left decubitus position
- Phased-array surface coil, centered over the region of interest (multiple gestation, large size of the fetus in the 3d trimester)
Procedure

• Locating Scout
• T2 -weighted ultrafast sequences (12s); to obtain images in the fetal axial, coronal & sagittal planes.
• T1-weighted fast : one or 2 planes for brain (myelinisation after 28 weeks), 3 planes for chest and abdomen
• Research : diffusion-weighted imaging, proton MR spectroscopy, faster sequences.
T2-weighted
3 planes
Fetal anatomy:

- **Central Nervous System**: US ventriculomegaly and isolated structural abnormality; abnormal cranial biometry
- **Fetal neck**: Lymphangioma is the commonest mass
- **Chest**: Unusual US aspect of specific lung malformations, congenital diaphragmatic hernia
- **Urinary & gastrointestinal tracts**
- **Tumors**: MRI may provide complementary information on the tumoral extent
CNS : MRI specificity

• Cerebral measurements
• Hemispheric symmetry, & cerebrospinal fluid
• Brain parenchyma: evaluation of the cerebral gyri; degree of gyration & myelinization: comparison with tables of normal development (Garel et al, 2001)
• Posterior fossa anatomy: midbrain
MRI fetal normal Brain, T2-weighted sequences 3 Planes, 2 GAge

28 W

Sagittal scan coronal scan axial

34 W
CNS : MRI specificity: Prognosis

• Associated anomalies for ventriculomegaly & structural abnormalities detected by US
  – Corpus callosum agenesis (ACC)
  – Septi pellucidi agenesis,
  – Dandy-Walker complex,
  – Arachnoïd cyst
  – Vascular anomaly

• Infections
  Cytomegalovirus (CMV), Toxoplasmosis
ACC: associated CNS abnormalities

Dandy-Walker 24 GW

Lissencephaly 26 SA

inter-Hémisphéric Arachnoïd cyst
Grande citerne asymétrique

ax

ACC partielle

sag
IRM à 29 SA
Dandy-Walker complex
Diagnosis US  Vascular malformation 3d trimester  MRI brain prognosis
3d Trimester; CMV infection: complementarity US-MRI

**US:** cephalic biometry decrease; mineralization of thalamo-striate vessels

**MRI:** prognosis: hemispheric hemi-atrophy and cortical gyral abnormality
CNS: applications for which US is limited

- Porencephaly, hemorrhage
- Cortical gyral abnormalities or cleft,
- Lobar holoprosencephaly,
- Prognosis of vascular malformation..
- Tuberous sclerosis: subependymal tubers
US: Asymmetric Ventriculomegaly

MRI: parenchyma hemorrhage (high-signal T1)
Mme Mel., 3d Trimester

US
Right ventriculomegaly 12mm,
Septi pellucidi agenesis?

MRI: Unilateral Schizencephaly
Tuberous sclerosis

3d trimester

T1 T2

rhabdomyomas
Chest/ Liver : C Diaph Hernia

- Fast spin-echo T2-weighted: very high signal of the lung
- T1-weighted: high signal of the liver
- Quantitative and qualitative evaluation of the lungs: curve of normal fetal lung volume (FLV) (*Rypens et al, 2001*)
Normal fetal Lung volume (FLV)
Rypens et coll
Multicenter study
GRRIF
(Bruxelles, Lille, Bordeaux, Necker, Lyon, Grenoble, Rouen)

Radiology 2001
Chest/ Liver : C Diaph Hernia

- Congenital Diaphragmatic Hernia: prenatal prognosis by the measured/expected FLV ratio threshold 25% (Gorincour et al, 2005)
- Serious ethical issues (to predict prenatal prognosis may lead to an increased demand for TOP)
30W Congenital diaphragmatic hernia
Abdomen (digestive tract, and peritoneum)

- Bowel obstruction: MRI analyzes the location of the obstruction, the visibility of small bowel not involved in the obstruction, the visibility and size of colon and rectum.
- Anorectal malformation: accuracy MRI > US (except small urodigestive fistula) (Garel C et al, 2006)
- Meconium peritonitis and pseudocyst
T2-weighted

Normal: Small bowel: hyper T2; Colon/rectum hyper T1

T1-weighted
Distal obstruction

US

MRI

T1

T2

microcolon
Meconial peritonitis and pseudo-cyst

MRI

- **T2-weighted**
  - Middle signal pseudocyst
  - Small bowel hyper T2

- **T1-weighted**
  - High signal = méconium
Fetal tumors and pseudotumors
the extent of the mass is best assessed by MRI

- Cystic Lymphangioma
- Teratoma and mediastinal neuroblastoma
- Mesoblastic nephroma
- Adrenal neuroblastoma
- Sacro-coccygeal teratoma: most common tumor in the neonate
Neck Cystic Lymphangioma
Mediastinal teratoma and hydrops

Differential Diagnosis With Cystic Adenomatoïd malformation

Mediastinum displacement
Sacro-Coccygeal Teratoma
Conclusion

• High quality sonogram performed before
• Multidisciplinary staff: MRI applications
• MRI applications increase: Ultrafast MRI techniques, research for the future (functional MRI)
• Complementary imaging: fetal anatomical details, prognosis for patient management
• Prenatal counseling: pediatric specialist’s can feel more confident about a specific diagnosis
• Continuity from in utero to postnatal imaging
Difficultés

- Information en amont, parfois ?
- Compétence en médecine foetale
- Interprétation définitive différée discordance possible
- Organisations pour avis pronostique pédiatrique « en suivant » : manque de temps pour analyse, réflexion, information
- Questions fréquentes : les Pourquoi ?!
US 29 W : Séquestration ?

Discrepancy between US and MRI
Foregut duplication
US cor scan: asymmetric VMegaly

MRI axial T2-weighted scan
Large Shizencephaly
Mme Gui...34 W.

Brain Oedema
Hemorrhage

TOP

T2