General Indications and Use of Fetal MRI

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Helpful factors in Fetal MRI

Bone does not impair assessment of underlying structures

Good quality in oligyhydramnios/anhydramnios

Large Field ovf View (late pregnancy weeks)

Connectivity and function
Linimiting factors in Fetal MRI

Expensive

Good qualita only in a few centers

At the moment not done in first trimester

Best information from GW 24 onwards

No doppler-like information

Not sensitive for calcifications
Elevated BMI + Anhydramnios

GWW
19+1
Indications: ACOG Recommendations

Common Indications:
- elevated BMI
- Oligo/ Anhydramnios
- Scarring of the abdomen
- Position of the fetus that allows only restricted US assessment

Special Indications:
- Situations, where MRI allows a better estimation of the intrauterine situation than US alone
Indications

- Brain
- Face
- Head
- Neck
- Thorax
- Gastrointestinal system
- Urogenital system
- Skeleton
- Placenta
Indications

- Posterior fossa anomalies
- Corpus callosum anomalies
- Diaphragmatic hernia
- Microcephaly
- Apparently isolated ventriculomegaly
- Neural tube defects
- Pulmonary anomalies
- Lymphangiomata
- Multiple malformations
- TTTS
- Skeletal dysplasia
- Cleft lip/palate
- Urinary tract anomalies
- Abdominal wall defects
- Previous familial history with normal US
- Monochorionic twins
- Congenital heart defect

Median Score

ISUOG Survey 2014
50 Centers
Face: Profile

31+3 GW

T2  
T1 TSE  
SSFP

Steady-state free precession (SSFP) sequences
Head

GW 27
Head
Rapidly Involuting Congenital Hemangioma
GW 27

GW 40
Neck: surface (+)

Mittermayer C et al
Ultraschall Med 2005
26(1)46-50
Neck: Thyroid gland

Maternal Hypothyreosis  GW 28

Maternal Euthyreosis  GW 29
Gastrointestinal Tract: Esophagus

GW 23+2
## Thorax: Lungs

<table>
<thead>
<tr>
<th>Intrathoracic</th>
<th>Extrathoracic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenital Diaphragmatic Hernia (CDH)</td>
<td>Oligohydramnios (renal and non-renal)</td>
</tr>
<tr>
<td>Hydrops fetalis and/or pleural effusion</td>
<td>Intrauterine growth restriction</td>
</tr>
<tr>
<td>Cystic adenomatoid malformations</td>
<td>Skeletal dysplasia</td>
</tr>
<tr>
<td>Bronchogenic cysts</td>
<td>Neuromuscular disease</td>
</tr>
<tr>
<td>Cardiac lesions/anomalies</td>
<td>Central nervous system abnormalities and fetal akinesia</td>
</tr>
<tr>
<td>Intrathoracic masses (other)</td>
<td>Abdominal wall defects</td>
</tr>
</tbody>
</table>

Pulmonary hypoplasia

Kasprian G
Chapter 26
In: Fetal MRI Ed
D.Prayer
Springer 2011
Thorax: Congenital diaphragmatic hernia

31 GW

Ultrasound

T2w

T1w

Liver

Stomach

Colon
Thorax: Congenital diaphragmatic hernia

T1 w, Z-projection: „Meconium-based Colonography“
Thorax: Congenital diaphragmatic hernia
Beyond Lung-to-head ratio: Volumetry

Cannie et al., 2008  
n=200

Kasprian et al., 2006  
n=106

Rypens et al., 2001  
n=215

Mean lung volume (ml) vs gestational age

Cannie et al., 2008  
n=200

Rypens et al., 2001  
n=215

Kasprian et al., 2006  
n=106

MRI of the normal fetal lung in: Prayer D. ed., Fetal MR Imaging
Thorax: Congenital diaphragmatic hernia

In vivo 3 Tesla MRT

22GW
Thorax: Congenital diaphragmatic hernia

Postmortem 3 Tesla MRT

23GW
Thorax: Congenital diaphragmatic hernia

Postmortem
3 Tesla MRI

In vivo
3 Tesla MRI

23GW

22GW

3D Visualization
### Thorax: Congenital diaphragmatic hernia

<table>
<thead>
<tr>
<th>Cases</th>
<th>Age (GW)</th>
<th>Minimum LV</th>
<th>TFLV (%)</th>
<th>Survival(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kasprian, Brugger et al.</td>
<td>28</td>
<td>19-38 (27.2)</td>
<td>6ml</td>
<td>&lt;12.5 &lt;25</td>
</tr>
<tr>
<td>Neff, Büsing et al. 2007</td>
<td>64</td>
<td>32-34 (33.8)</td>
<td>5ml 10ml</td>
<td>&lt; 25 &gt; 25</td>
</tr>
<tr>
<td>Gorincour et al. 2005</td>
<td>77</td>
<td>24-37</td>
<td>&lt; 25 &gt; 25</td>
<td>19 60</td>
</tr>
<tr>
<td>Mahieu-Caputo et al 2001</td>
<td>11</td>
<td>28-37 (&gt;30)</td>
<td>&lt;6ml lethal</td>
<td>&lt; 35 ≥ 35</td>
</tr>
</tbody>
</table>

**Beyond Lung-to-head ratio Volumetry**
Congenital diaphragmatic hernia
Pulmonary hypoplasia

Hydrothorax
PROM
Abdominal RF

"critical" LV: 9ml

"critical" LV: 6ml

CDH

Tissue remodeling!
Beyond Lung-to-head ratio Volumetry

Postmortem
3 Tesla MRI

Liver!

In vivo
3 Tesla MRI

Liver!
Congenital diaphragmatic hernia

Diaphragm

Postmortem
3 Tesla MRI

In vivo
3 Tesla MRI
Congenital diaphragmatic hernia

Diaphragm

Postmortem
3 Tesla MRI

In vivo
3 Tesla MRI
Ordering is as easy as...

1. Get your 3D ultrasound or take baby pictures
   (jpg, png, or other typical image files accepted)

2. Place your order online and upload pictures
   (Use website to provide details)

3D. We create your 3D Baby and ship it to you
   (3D Baby ships within 2-3 weeks)
Congenital diaphragmatic hernia
Diaphragm – functional assessment

fetal breathing movements

Thorax: lungs
CDH
Abdomen: Liver

Drop of T1-weighted liver signals in metabolic syndromes hemochromatosis

GW 30
Gastrointestinal Tract: large bowels

GW 23+5  Large urinary bladder, Hydronephrosis

Megacystis Microcolon Intestinal Hypoperistalsis Syndrome
Gastrointestinal Tract: small bowels

Ileal atresia + apple peel

Apple peel: remainder of small bowel coiled around ileocolic artery

Abdomen: Spleen

Heterotaxy syndrome with polysplenia GW 34+2
Due to an embryological failure of lateralization

Midline liver  3 spleens  Applegate et al, Radiographics 1999
Abdomen: kidneys

Unilateral ektopic kidney

GW 25+5

Ectopic renal pelvis right
Pelvic kidney left
“Fetal MRI is virtually blind to bones…”

Bones

EPI Sequence

GW 28+0
Thanatophoric Dysplasia

- micromelia
- short long bones
- spiking of the metaphyses / irregular metaphyses
- redundant skin folds
Thanatophoric Dysplasia
To operate, L1CAM need interactions with FGFRs, whose defects are causal to the syndromic craniosynostoses.

1st MRI, 21 gestational weeks

abnormal head shape

Apert Syndrome!

GW 29

FGFR2 Exon 8: c1040C>G (rs121918494, p.Ser347Cys)
Apert Syndrome

Acrocephalosyndactyly

GW 21

GW 22+5
Indications for fetal MRI depend on many factors

As a general rule: do it when you think it might help!
Gastrointestinal Tract: Esophagus

US: Polyhydramnios stomach?