

# The role of MRI in congenital malformations: preliminary results of a multidisciplinary approach.

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# Introduction

- MRI is 3<sup>rd</sup> level examination
- To confirm sonography findings and detect associated anomalies

## Sonography

- 1<sup>st</sup> Trimester: 10-12 weeks
- 2<sup>nd</sup> Trimester: 20-22 weeks
- 3<sup>rd</sup> Trimester: 32-34 weeks



# MRI indications According to GA

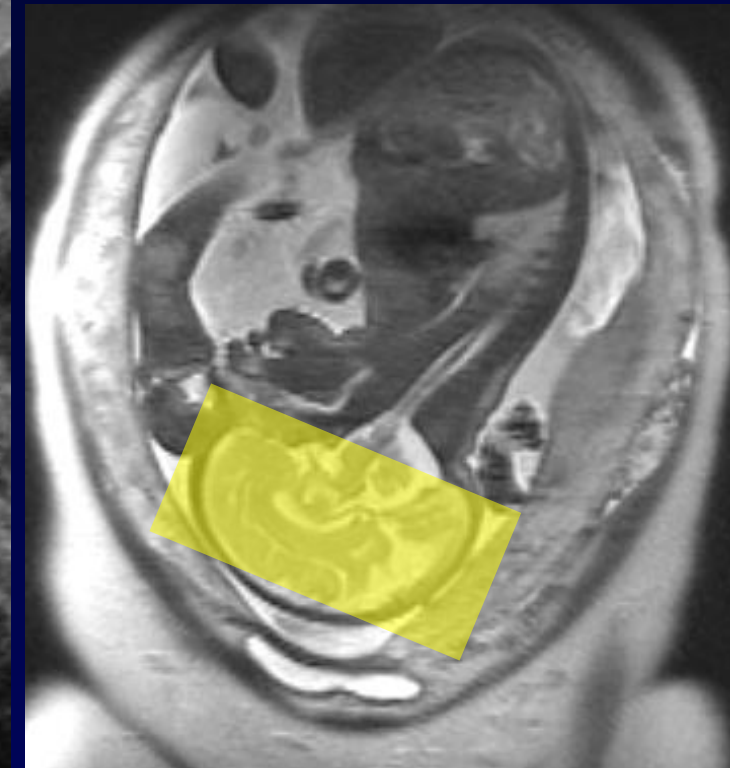
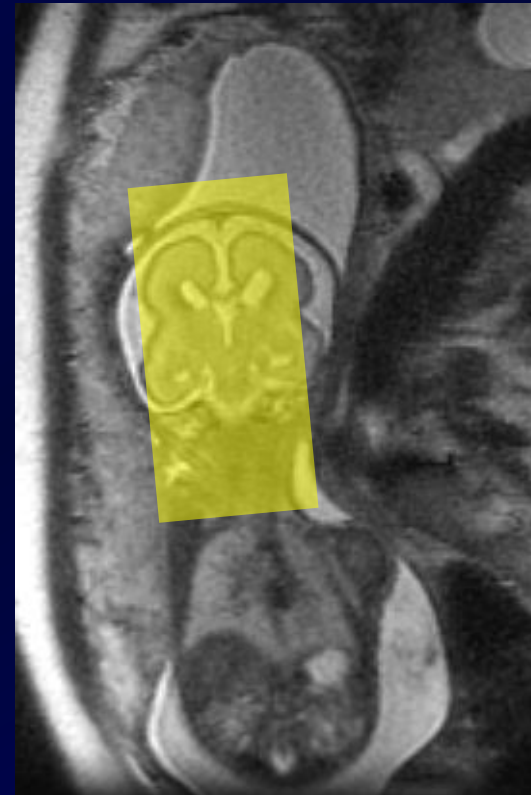
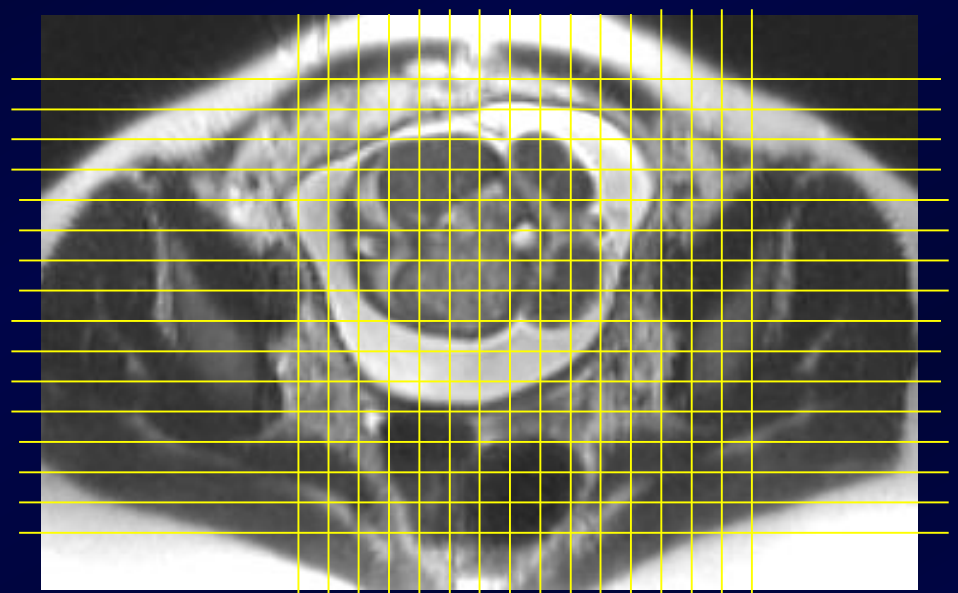
- **1<sup>st</sup> Trimester:**
  - Maternal causes
- **2<sup>nd</sup> Trimester:**
  - Brain development
  - Fetal anomalies:
    - Ventriculomegaly; posterior fossa; cortex, neuronal migration disorders
- **3<sup>rd</sup> Trimester:**
  - Biometry; placenta previa/accreta; Infections

# Materials and method

- 56 pregnant women MRI were examined during 2<sup>nd</sup> and 3<sup>rd</sup> trimester
- US diagnosis: fetal anomalies
- US examination doubtful or incomplete
  
- MRI technique
  - *Half Fourier* pulse sequences: (SS-FSE)
  - Fast gradient echo imaging in steady-state precession: (FIESTA)
  - DWI
  - T1 GRE fat-sat

# MRI Technique

- 3 orthogonal planes according to the mother
- 3 orthogonal planes according to the medical need
- No contrast



# Results

- CNS anomalies were the most frequent (60%), followed by abdominal anomalies (16%)

District involved	Number of fetuses
Central nervous system	34
Face and neck	3
Thorax	4
Abdomen	9
Musculoskeletal	1
US doubtful/incomplete	5
Total	56



# CNS Anomalies

- Most difficult to detect at US
- Evaluation of associated anomalies
- MRI main indications:
  - Ventriculomegaly
  - Posterior fossa anomalies
  - Migration disorders

CENTRAL NERVOUS SYSTEM		
Final Diagnosis	US Diagnosis	MR Diagnosis
Unilateral ventriculomegaly	Unilateral ventriculomegaly	Unilateral ventriculomegaly
Sacroccocygeal teratoma	Sacroccocygeal teratoma	Sacroccocygeal teratoma
Unilateral ventriculomegaly	Unilateral ventriculomegaly	Unilateral ventriculomegaly
Dandy-Walker Syndrome	Dandy-Walker Syndrome	Dandy-Walker Syndrome
CENTRAL NERVOUS SYSTEM		
Final Diagnosis	US Diagnosis	MR Diagnosis
Hydrocephalus	Hydrocephalus + corpus callosum agenesis	Hydrocephalus
Normal ventricles	Bilateral ventriculomegaly	Normal ventricles
Chiari II malformation + myelomeningocele	Myelomeningocele	Chiari II malformation + myelomeningocele
Arachnoid cyst	Unilateral ventriculomegaly	Unilateral ventriculomegaly
Chiari II malformation + myelomeningocele	Myelomeningocele	Chiari II malformation + myelomeningocele
Corpus callosum agenesis	Bilateral ventriculomegaly	Corpus callosum agenesis
Chiari II malformation + myelomeningocele + VM	Myelomeningocele	Chiari II malformation + myelomeningocele + VM
Cavum vergae	Intracranic cyst	Cavum vergae
Negative	Meningocele	Negative
Normal ventricles	Unilateral ventriculomegaly	Normal ventricles
Dandy-Walker Syndrome + microphthalmia	Dandy-Walker Syndrome	Dandy-Walker Syndrome + microphthalmia
Normal ventricles	Bilateral ventriculomegaly	Normal ventricles
Normal ventricles	Bilateral ventriculomegaly	Normal ventricles
Sacroccocygeal teratoma	Sacroccocygeal teratoma	Sacroccocygeal teratoma
Hydrocephalus	Hydrocephalus	Hydrocephalus
Unilateral ventriculomegaly	Unilateral ventriculomegaly	Unilateral ventriculomegaly
Cerebellar vermis hypoplasia	Cerebellar vermis hypoplasia	Cerebellar vermis hypoplasia
Unilateral ventriculomegaly	Unilateral ventriculomegaly	Unilateral ventriculomegaly
Dandy-Walker Syndrome	Dandy-Walker Syndrome	Dandy-Walker Syndrome

# Other districts

FACE AND NECK		
Final Diagnosis	US Diagnosis	MR Diagnosis
Cavernous hemangioma	Cavernous hemangioma	Cavernous hemangioma
Cystic lymphangioma	Cystic lymphangioma	Cystic lymphangioma
Retronucal edema	Occipital meningocele	Retronucal edema
Cervical teratoma	Cystic lymphangioma	Cervical teratoma
THORAX		
Final Diagnosis	US Diagnosis	MR Diagnosis
Diaphragmatic hernia	Diaphragmatic hernia	Diaphragmatic hernia
Diaphragmatic hernia	Diaphragmatic hernia	Diaphragmatic hernia
Pulmonary sequestration	CCAM II	CCAM II
Pulmonary sequestration	CCAM II	CCAM II

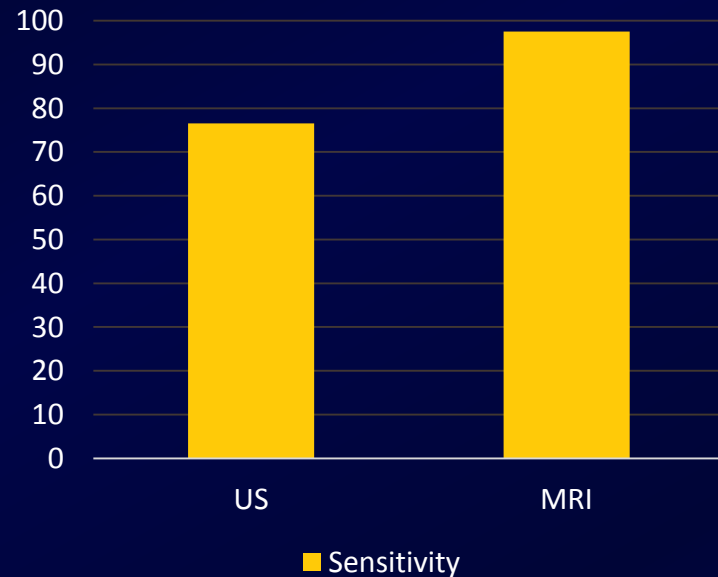
ABDOMEN		
Final Diagnosis	US Diagnosis	MR Diagnosis
Horseshoe kidneys	Horseshoe kidneys	Horseshoe kidneys
Colorectal distension	Colorectal distension	Colorectal distension
Double renal district	Ureterocele	Double renal district
Hepatomegaly	Hepatomegaly	Hepatomegaly
Ascites	Ascites + suspect intestinal duplication	Ascites + suspect intestinal duplication
Gastroschisis	Gastroschisis	Gastroschisis
Cystic lymphangioma	Renal cyst	Cystic lymphangioma
Peritoneal cyst	Intestinal duplication	Peritoneal cyst
Multicystic kidney	Multicystic kidney	Multicystic kidney
MUSCULOSKELETAL		
Final Diagnosis	US Diagnosis	MR Diagnosis
Hemivertebra	Congenital scoliosis	Hemivertebra



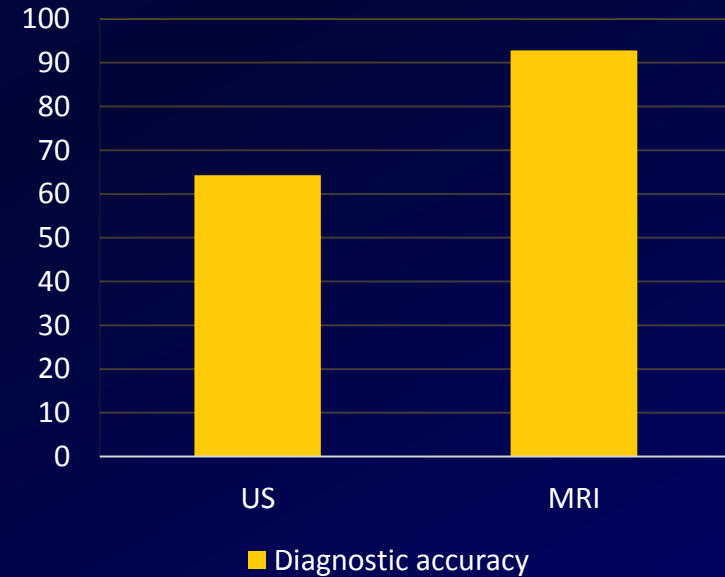
# Results

- Sensitivity: US 75.6 % vs. MRI 97.5 %
- Diagnostic accuracy: US 64.3 % vs. MRI 92.8 % ( $p 0,002$ )

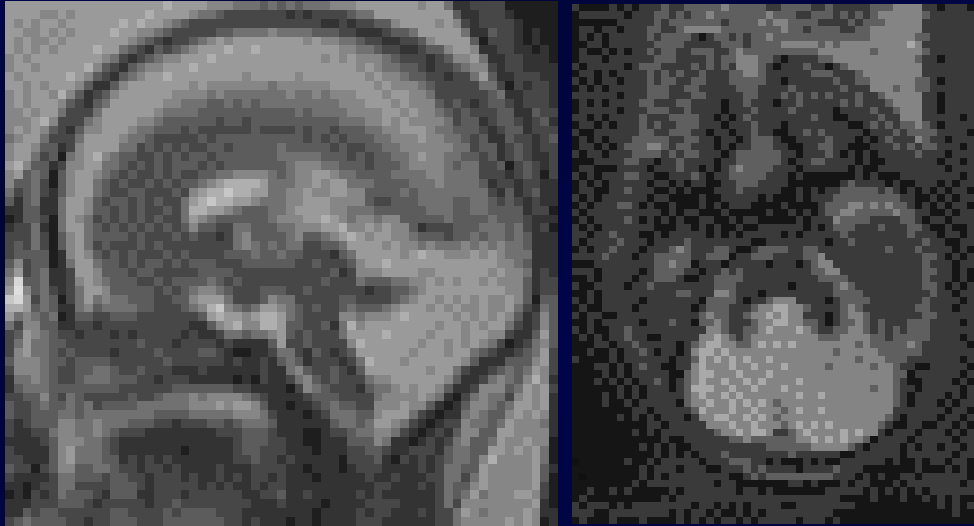
Sensitivity (%)



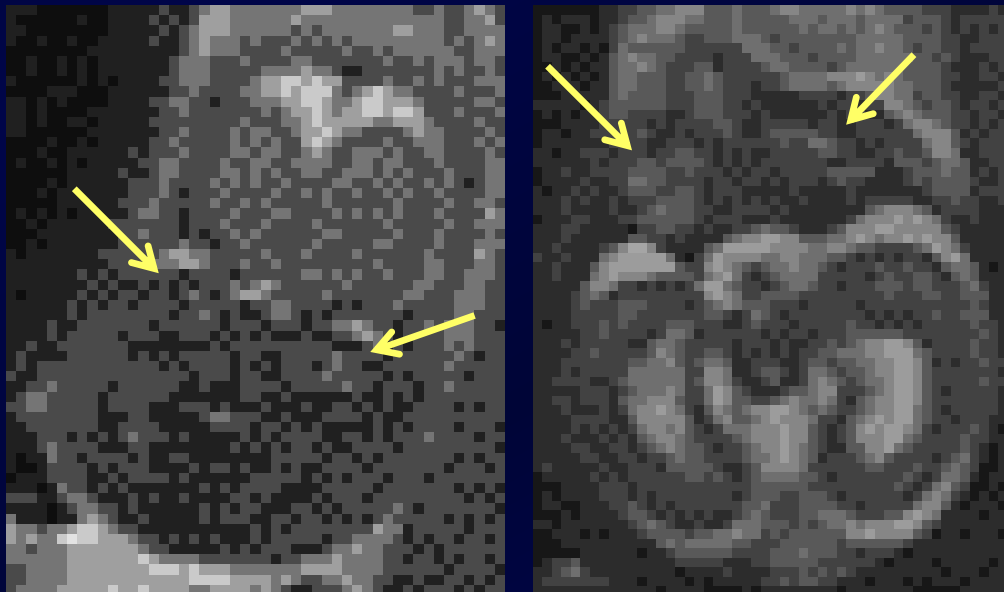
Diagnostic accuracy (%)



# CNS Anomalies: Dandy-Walker Syndrome



21 weeks



Bilateral microphthalmia

Changes prognosis

# CNS Anomalies: Chiari malformation type II

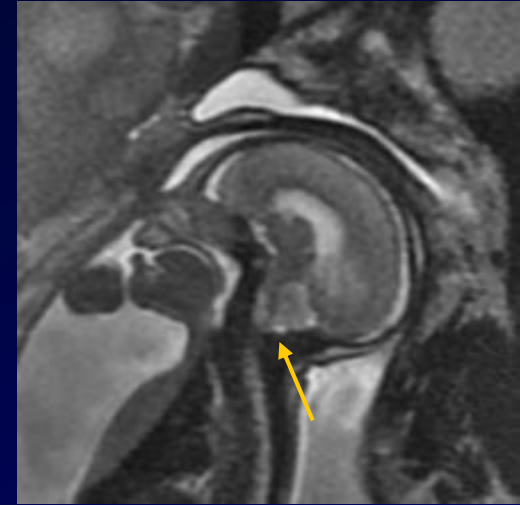
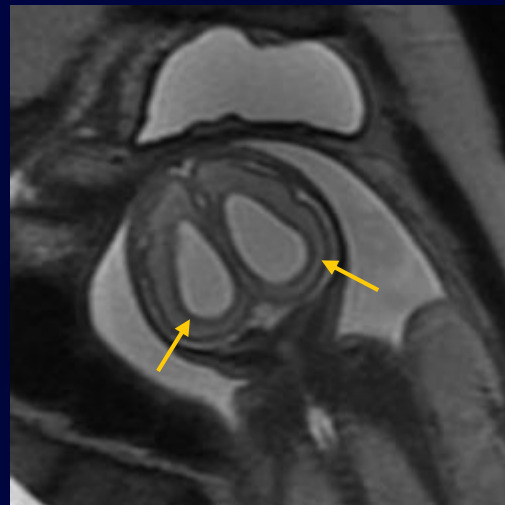
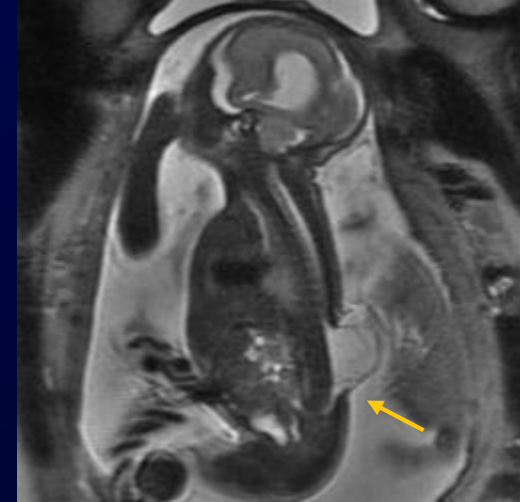
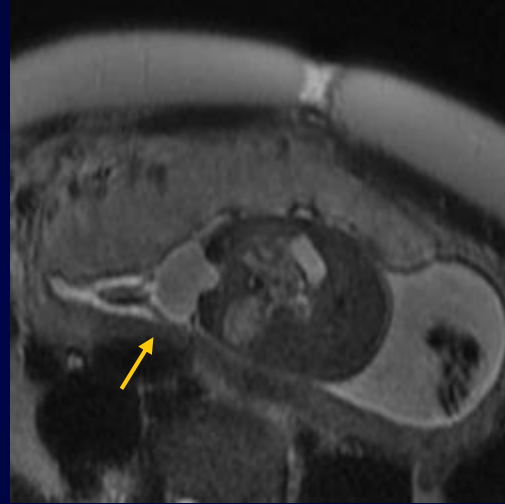
Gestational age: 25 weeks

US diagnosis:

- Myelomeningocele

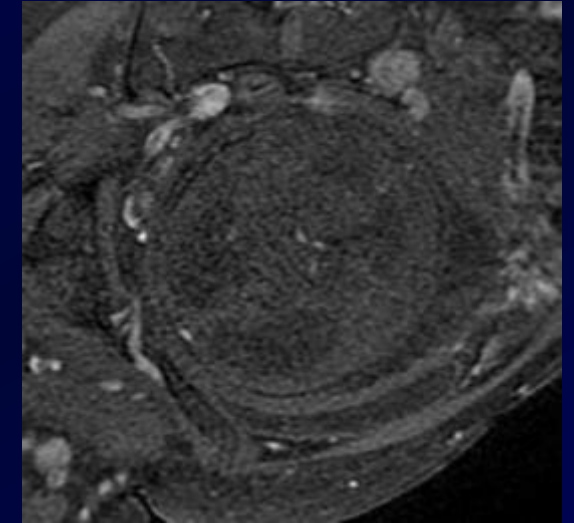
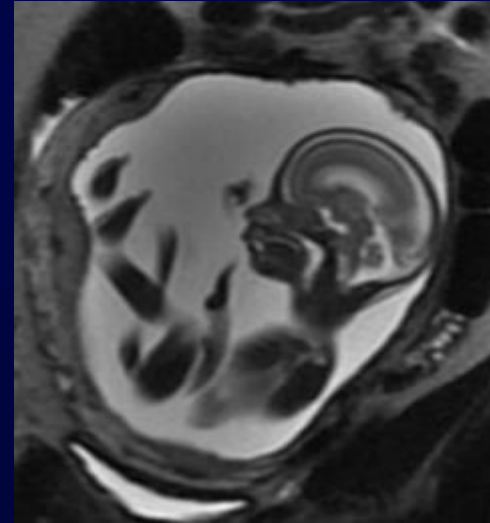
MRI diagnosis:

- Chiari malformation type II
- Bilateral ventriculomegaly



# MRI Limitations

- <20 weeks:
  - Fetal movements
  - Small anatomy
- Lack of reproducibility of T1-WI
- Generates maternal anxiety
- High cost, low availability, lack of real time imaging, metallic implants



# US vs. MRI

## US advantages:

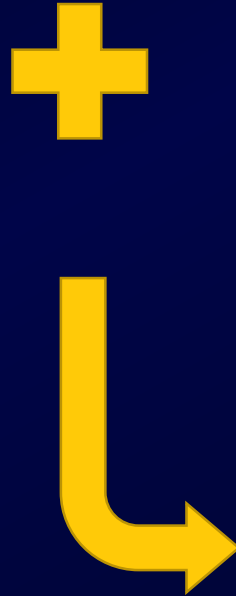
- ✓ Easily accepted
- ✓ Readily available
- ✓ Real-time examination

## US limitations:

- Poor contrast resolution
- Limited penetration
- Hampered by maternal body habitus

## MRI advantages:

- ✓ High contrast resolution
- ✓ Multi-planarity
- ✓ Large field of view



## Multidisciplinary approach

### Working group

- Obstetrician
- Radiologist
- Pediatrician
- Neonatal surgeon
- Geneticist
- Specialist surgeon

# Conclusion

- Diagnostic accuracy increases of 28.5 % performing MRI after sonography (92.8 % vs. 64.3 % on US examination)
- MRI in pregnant women has revolutionized our ability to image the fetus
- Sonography continues to be the primary screening modality during pregnancy, but MRI represents a powerful complimentary modality



Thanks for your attention

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