Prenatal MRI diagnosis of posterior fossa malformations and assessment of neurodevelopmental outcome

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Real life

- You are expecting your first child, 32 weeks of pregnancy, and after a screening test, you have been told by your charming physician that there was an incidental finding in the fetus' brain, on MRI.

What will be your next question?


The finding may correlate with an unspecified outcome...

What would you do, regarding your physician's answer...?

Outline

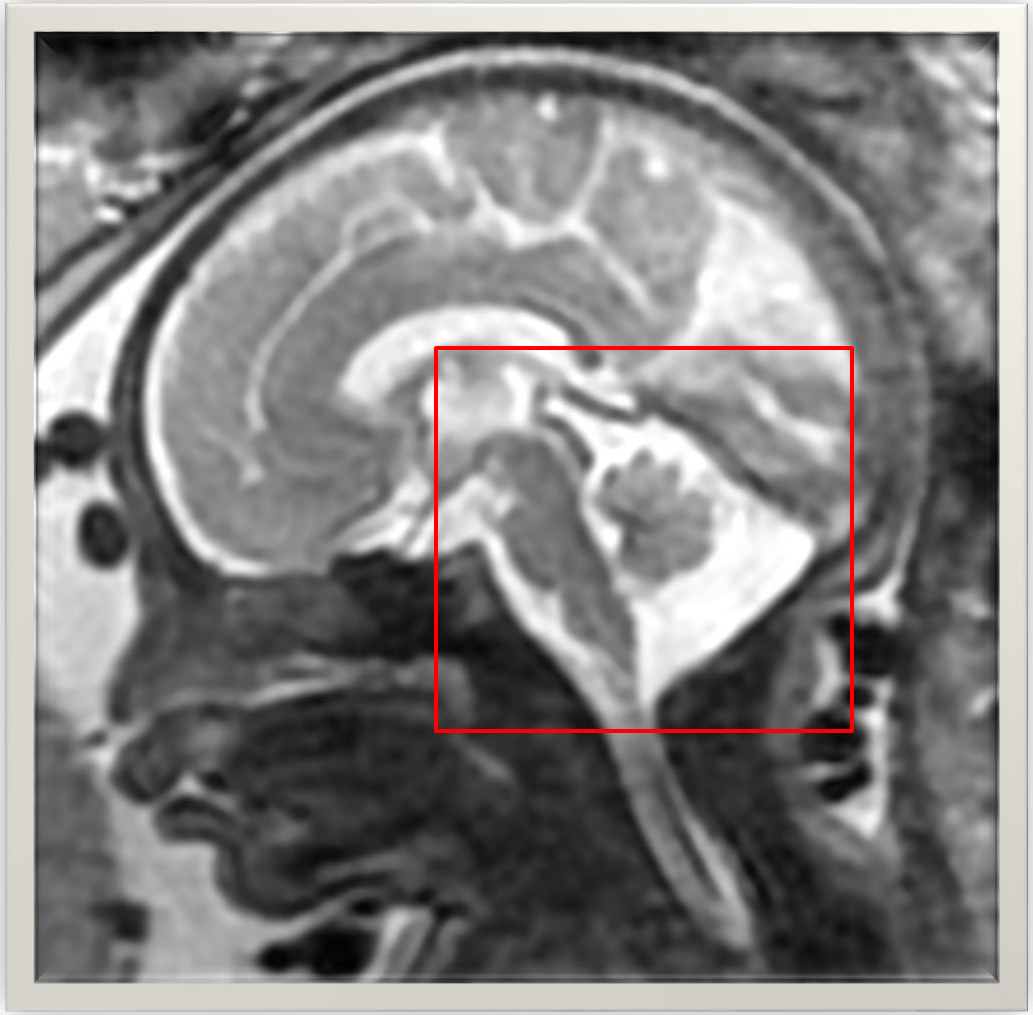
- The challenge
- Quick anatomy overview of the posterior fossa
- Classic example of posterior fossa malformation
- Our study:
  1. First step – measurements of the PF
  2. Second step – Neurological correlation

PF malformations – The challenge

- **A common finding**
- **Broad spectrum of diagnoses and prognoses**
- **No universally acceptable classification:**
  - ✓ *Patel and Barkovich* (2002):
    Hypoplasias and displasias
  - ✓ *Tortori-Donati* (2005):
    Cystic and non-cystic
  - ✓ *Guibaud* (2006):
    Agenesis: Complete or partial absence of a structure
    Hypoplasia: Small but complete structure
    Atrophy: Secondary volume diminution

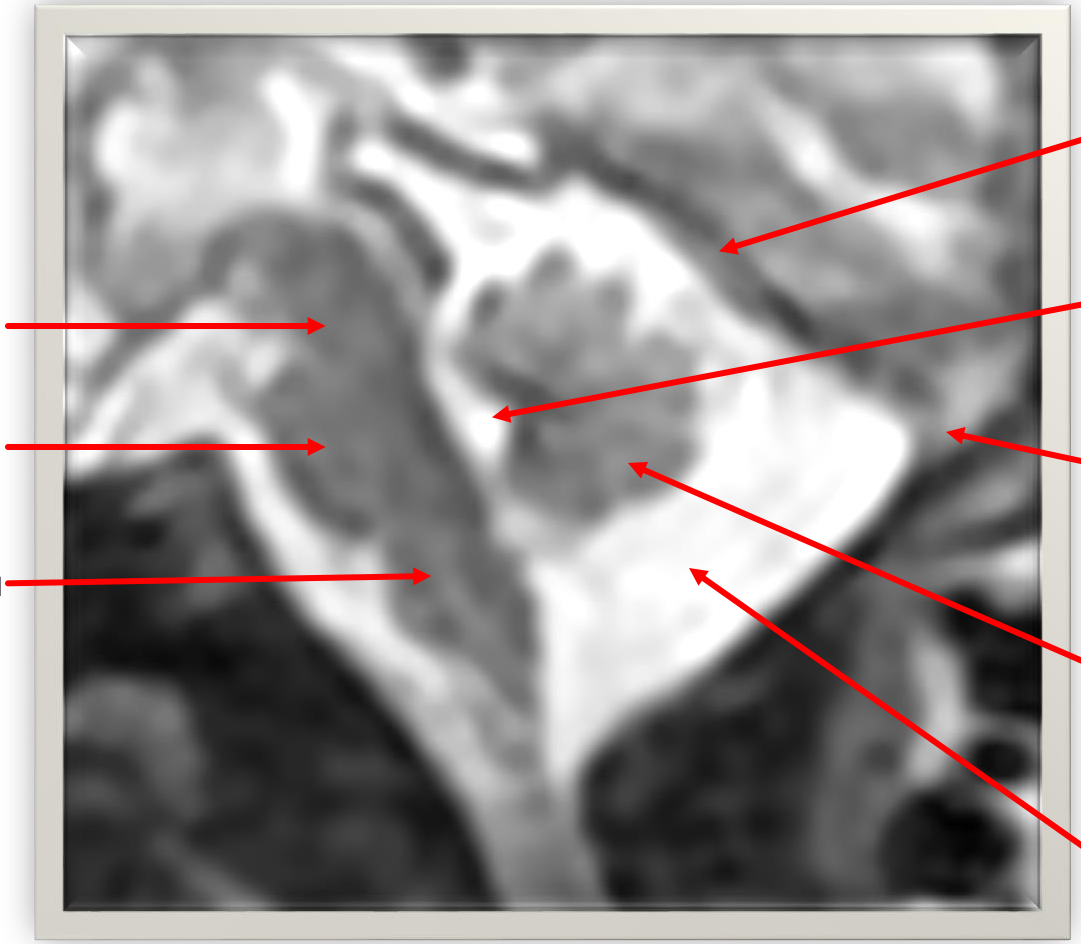
Anatomy of the PF

Midsagittal plane



Anatomy of the PF

Midsagittal plane



Brainstem
- Midbrain
- Pons
- Medulla oblangata

Tentorium Cerebelli

4th Ventricle

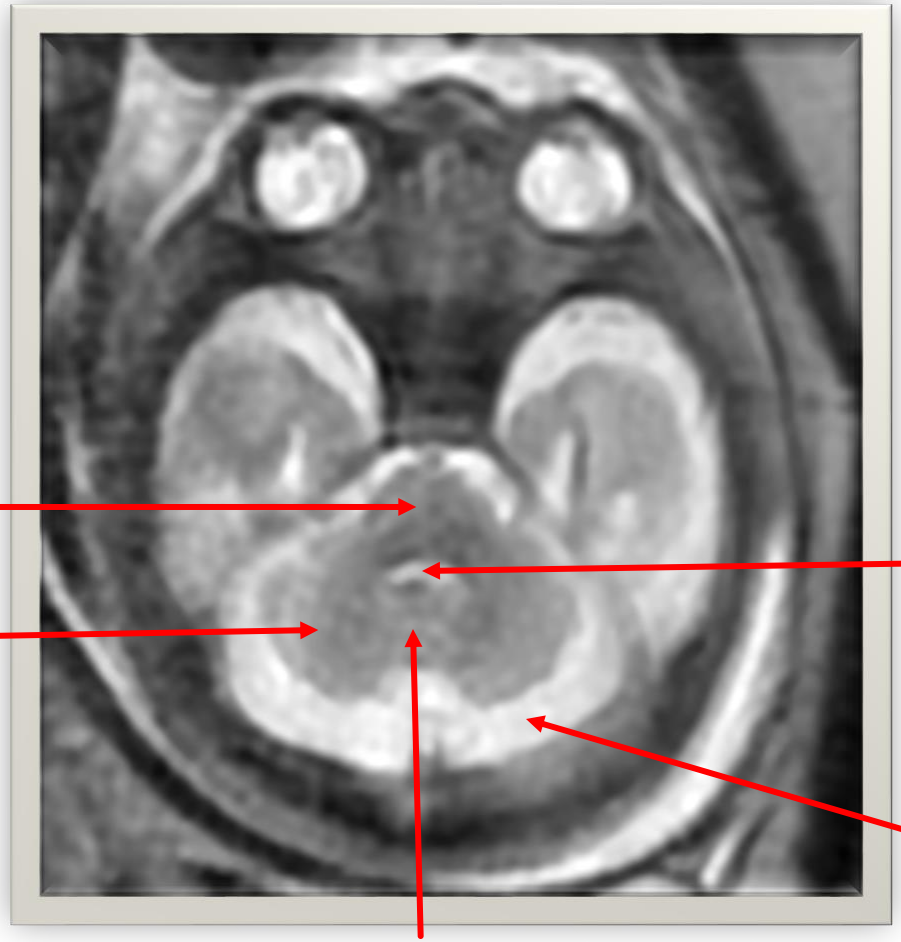
Torcular

Vermis

Cisterna Magna (CM)

Anatomy of the PF

Axial plane



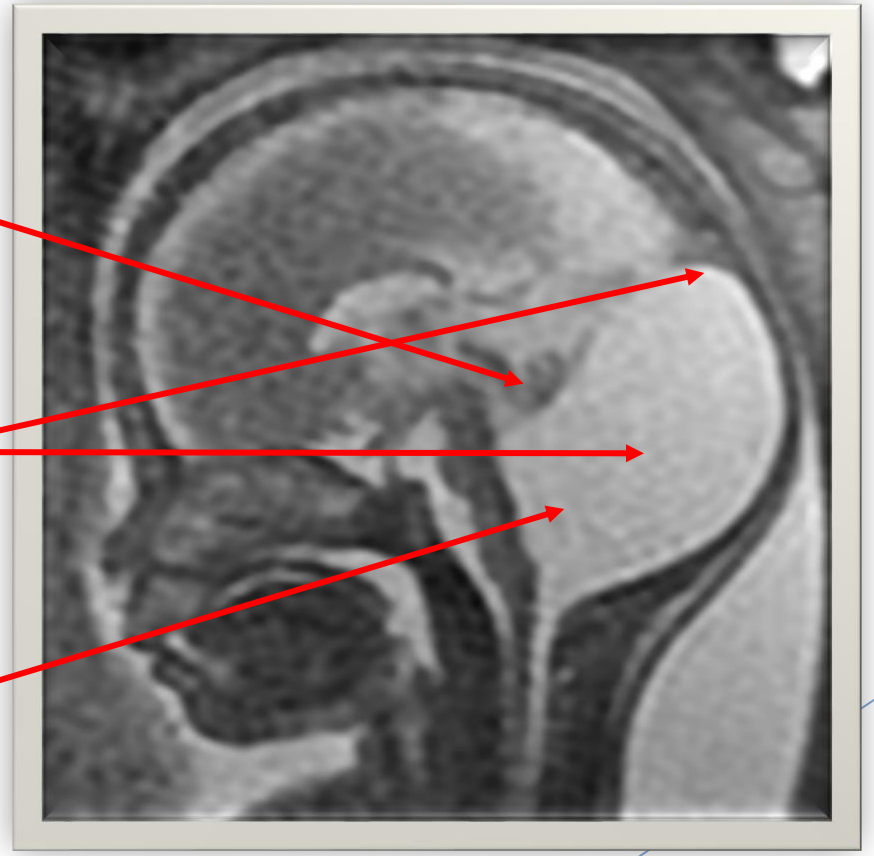
Dandy-Walker Malformation

- Recognized by Dandy 1914 (described by Virchow 1863)
- The classic triad:

Complete/partial vermian agenesis

Enlarged PF with upward displacement of the tentorium and the torcular

Cystic dilation of the 4th ventricle



Dandy-Walker Malformation

- Well defined anatomical entity
- Isolated or as a part of a syndrome (Joubert, Walker-Warburg and more)
- Prognosis varies

- Other PF malformations:
  - ✓ With enlargement of the CM: Blake's pouch, Arachnoid cyst, Mega CM
  - ✓ Without enlargement of the CM: Dysplasia, asymmetry, infections, ischemia…

Our Study

Objectives:

Step 1 (last year) - Re-evaluation of existing reference data and evaluation of new biometric reference data

Step 2 (current year) - Assess a correlation between abnormal findings on MRI and neurodevelopmental outcome.

Step 1

- A retrospective review of 215 fetal MR imaging examinations with normal findings and 5 examinations of fetuses with a suspected pathologic posterior fossa.
- 6 previously reported parameters and 8 new parameters were measured. 3 new parameter ratios were calculated.

R Ber, O Bar-Yosef, C Hoffmann et al. **Normal Fetal Posterior Fossa in MR Imaging: New Biometric Data and Possible Clinical Significance.** AJNR 2015; 36: 795-802

Step 1 – Summary of results

ICC

Variable	ICC	95% CI	Mean difference	Std difference	95% LOA
CS (cm^2)	0.983	(0.96,0.99)	0.275	0.371	(-0.45,1)
CP (mm)	0.977	(0.95,0.99)	2.528	2.553	(-2.48,7.53)
TCD (mm)	0.975	(0.94,0.99)	0.867	0.947	(-0.99,2.72)
VH (mm)	0.964	(0.92,0.98)	0.319	0.58	(-0.82,1.46)
CMS (mm^2)	0.96	(0.91,0.98)	-20.434	22.022	(-63.6,22.73)
VS (mm^2)	0.954	(0.9,0.98)	10.774	13.712	(-16.1,37.65)
VALS (mm^2)	0.954	(0.9,0.98)	1.385	6.556	(-11.46,14.23)
VPLS (mm^2)	0.938	(0.87,0.97)	6.706	10.424	(-13.72,27.14)
BSS (mm^2)	0.889	(0.77,0.95)	4.31	24.82	(-44.34,52.96)
PS (mm^2)	0.871	(0.73,0.94)	-0.352	13.292	(-26.4,25.7)
APDV (mm)	0.824	(0.64,0.92)	0.415	1.09	(-1.72,2.55)
APDP (mm)	0.804	(0.61,0.91)	0.177	0.704	(-1.2,1.56)
VP (mm)	0.68	(0.4,0.84)	5.5	5.308	(-4.9,15.9)
PH (mm)	0.68	(0.4,0.84)	0.253	0.803	(-1.32,1.83)

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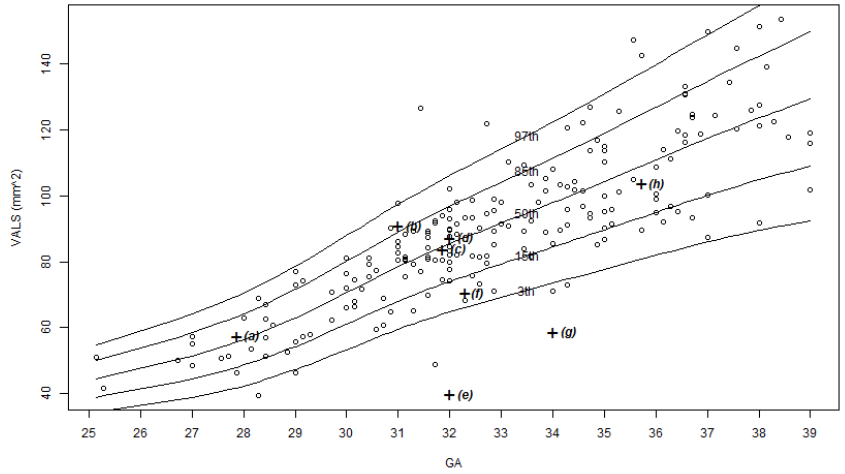
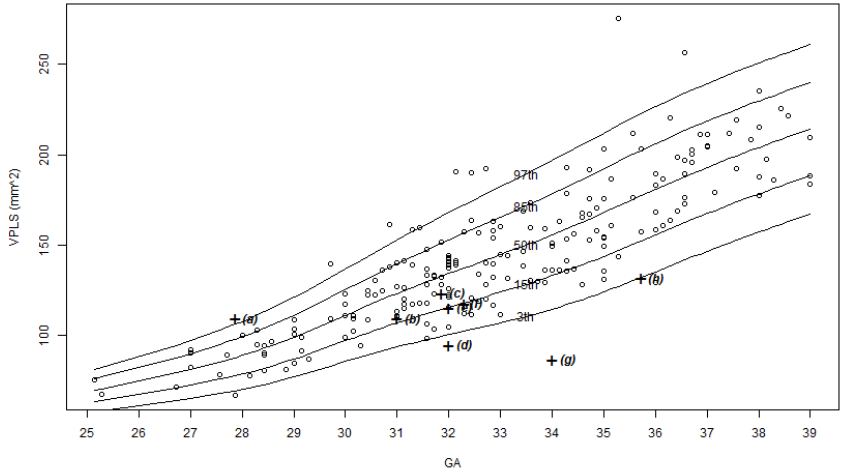
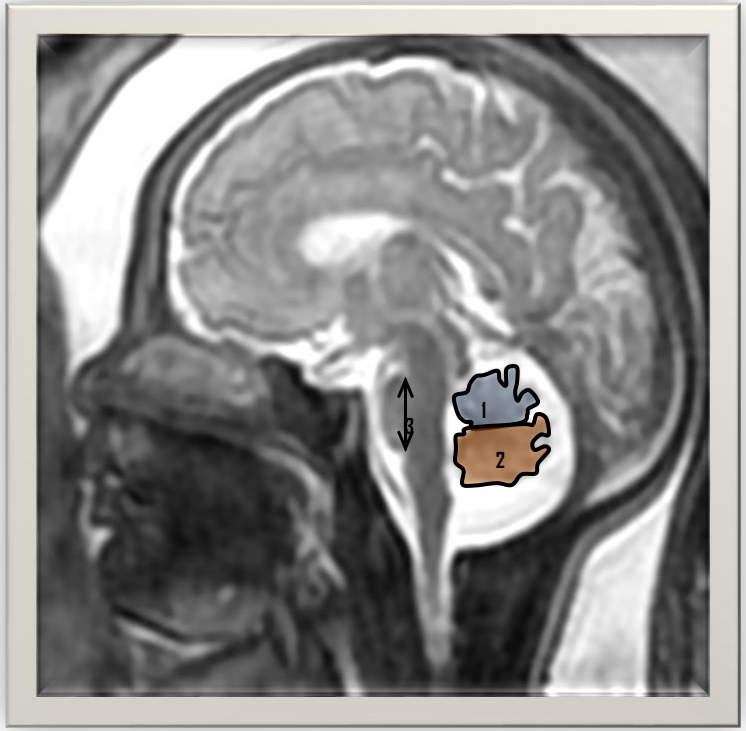
Step 1 Percentile curves







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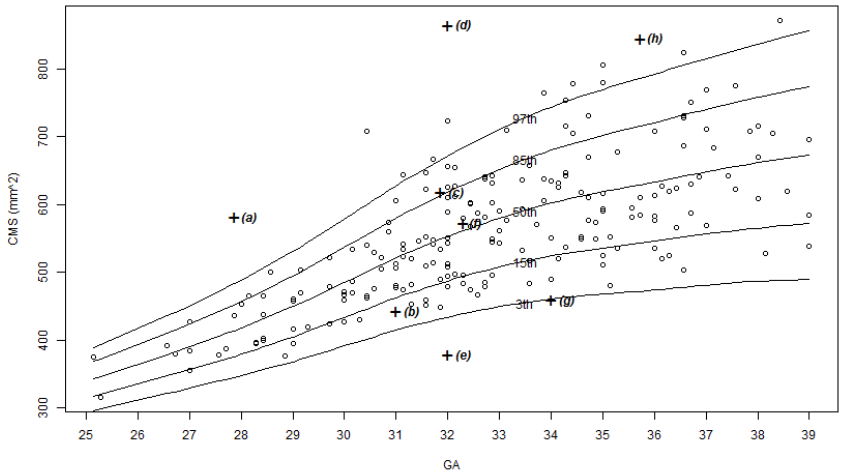

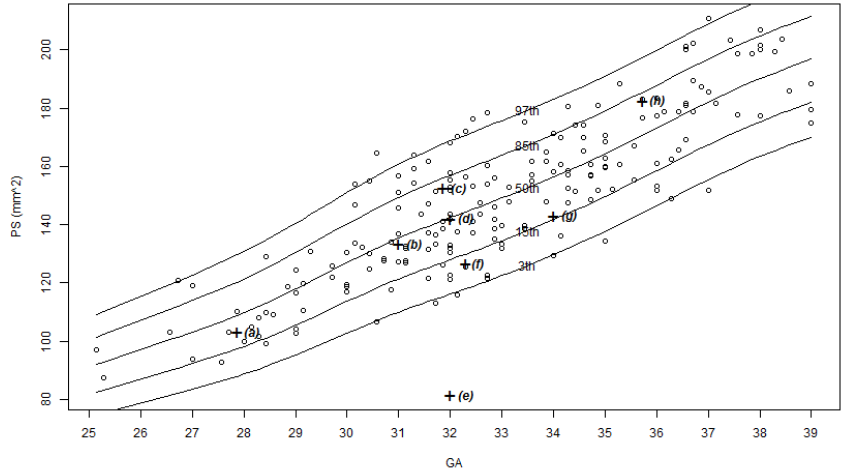

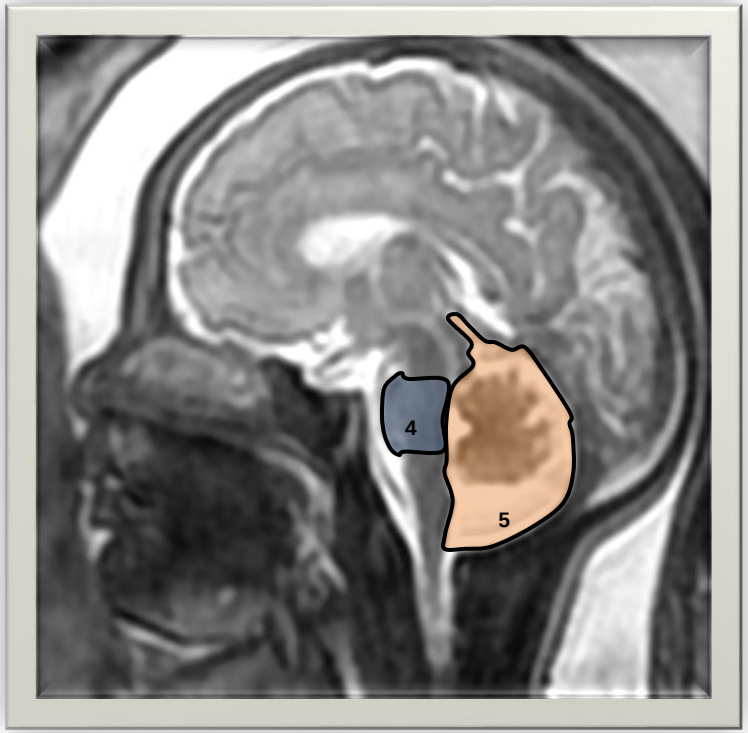

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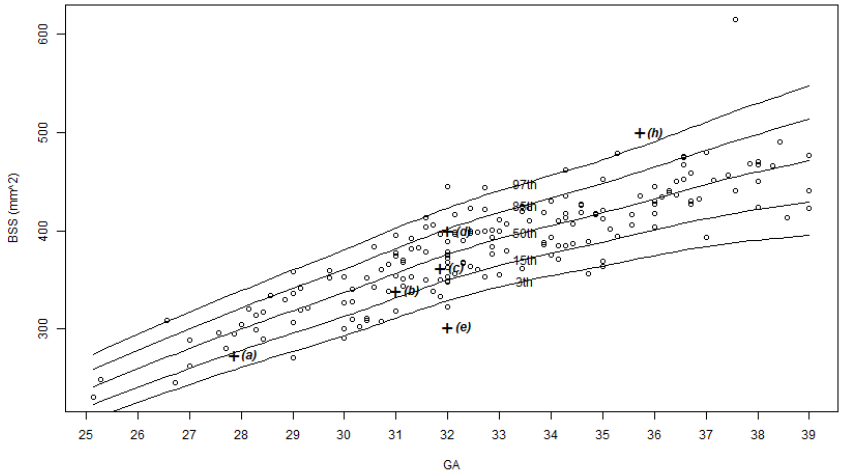

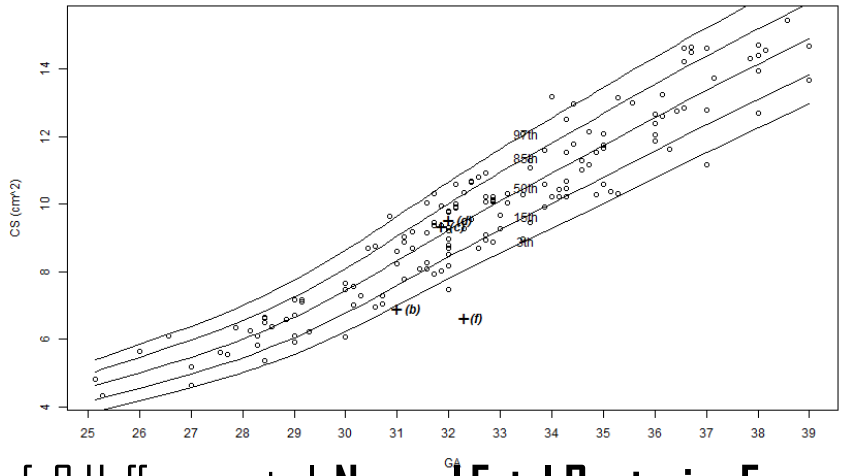

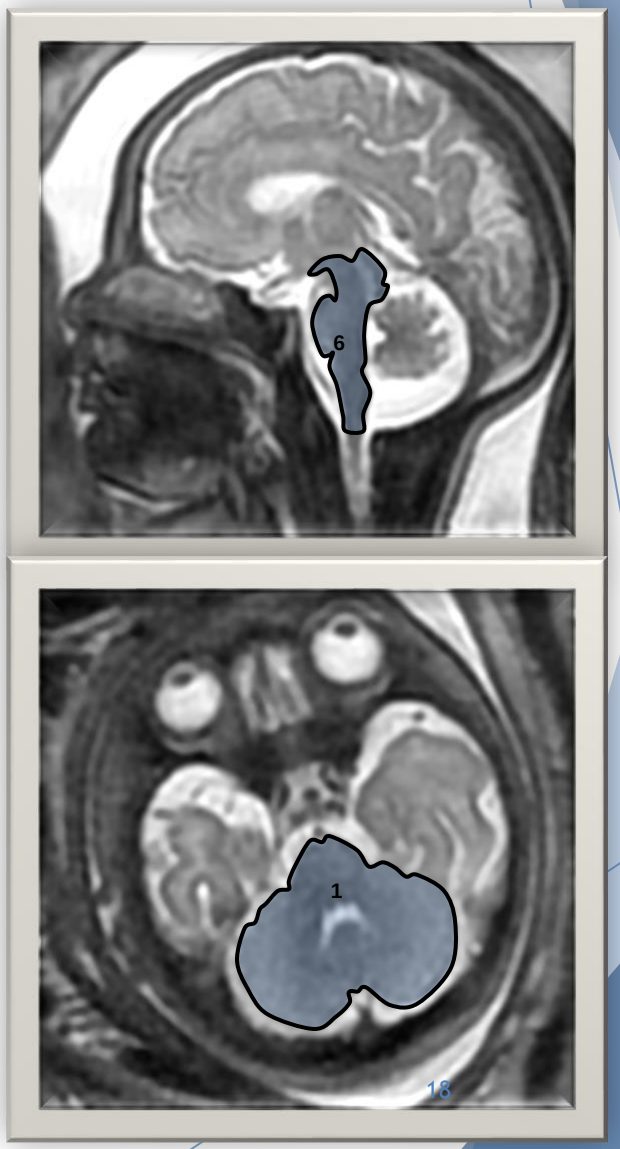

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Application of the new data on selected pathologic cases

Abnormal measurements of pathologic cases

Case	Gestational Age (weeks)	Indication for MRI	Abnormal Measurements
A	31.0	Cerebellar asymmetry	CHR, TCD, CS, and CP below 3rd percentile
B	31.6	Enlarged cisterna magna	No abnormal measurements
C	32.0	Suspected abnormal vermis	VS, VPLS, and VCMR below 3rd percentile; CMS and VLR above 97th percentile
D	34.0	Suspected abnormal vermis	APDV, VH, VS, VP, VALS, and VPLS below 3rd percentile
E	32.0	Low TCD measurements and suspected abnormal brain stem	TCD, CS, and CP below 3rd percentile

Note:—APDV indicates anteroposterior diameter of the vermis; VH, vermian height; VALS, vermian anterior lobe cross-sectional area; CP, cerebellar perimeter; CS, cerebellar cross-sectional area; VPLS, vermian posterior lobe cross-sectional area.

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What was missing in the first step…?

The main limitation of this study is that we demonstrated the possible clinical significance of the new data only by applying it on selected pathologic cases. We did not compare the diagnoses we made by using these data with the previous evaluations of the pathologic cases, postnatal imaging, and their clinical outcomes.

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Current step

Reevaluation of 50 embryos with abnormal findings on MRI in the posterior fossa, using the percentile curves we established in step 1, comparison to original diagnoses, Postnatal diagnosis and neurodevelopmental assessment of the children.

Current step

The neurodevelopmental assessment will be made in ages 1-3 years, using validated telephone questionnaire (Vineland adaptive behavior scale).

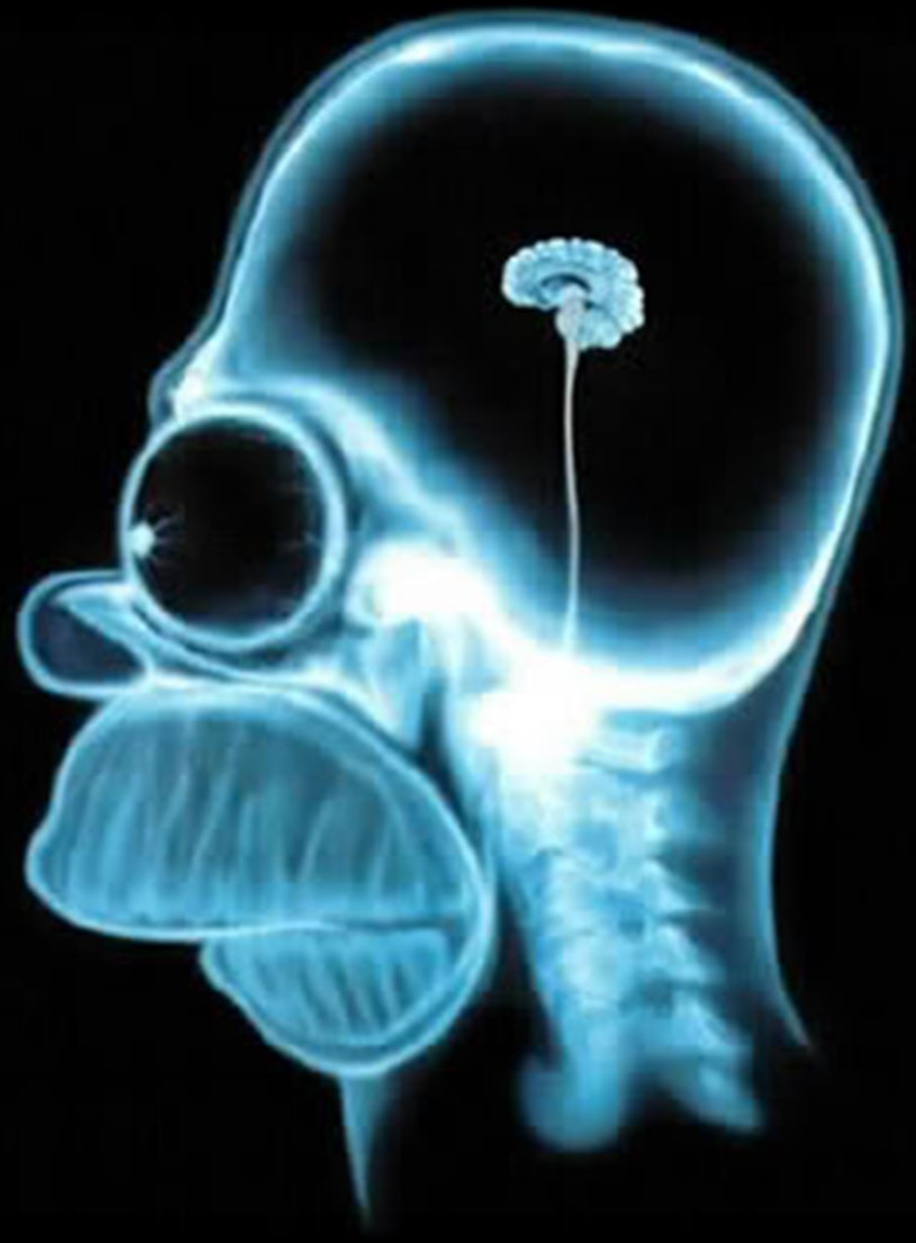
Current step

Children with abnormal score on the Vineland will be referred to a more thorough neurological test, including clinical inspection of the child (Griffith mental developmental scales).

To complete the picture, several medical data will be collected, including other US & MRI findings, medical chart, genetic consultation reports, lab results, and more.

Our Hope

We hope our study will enable future physicians in assessing possible neurodevelopmental outcomes, based on PF measurements, thus allowing the parents to make an informed decision.



THANK YOU!