Normal Fetal Posterior Fossa: New Biometric reference data and Possible Clinical Significance

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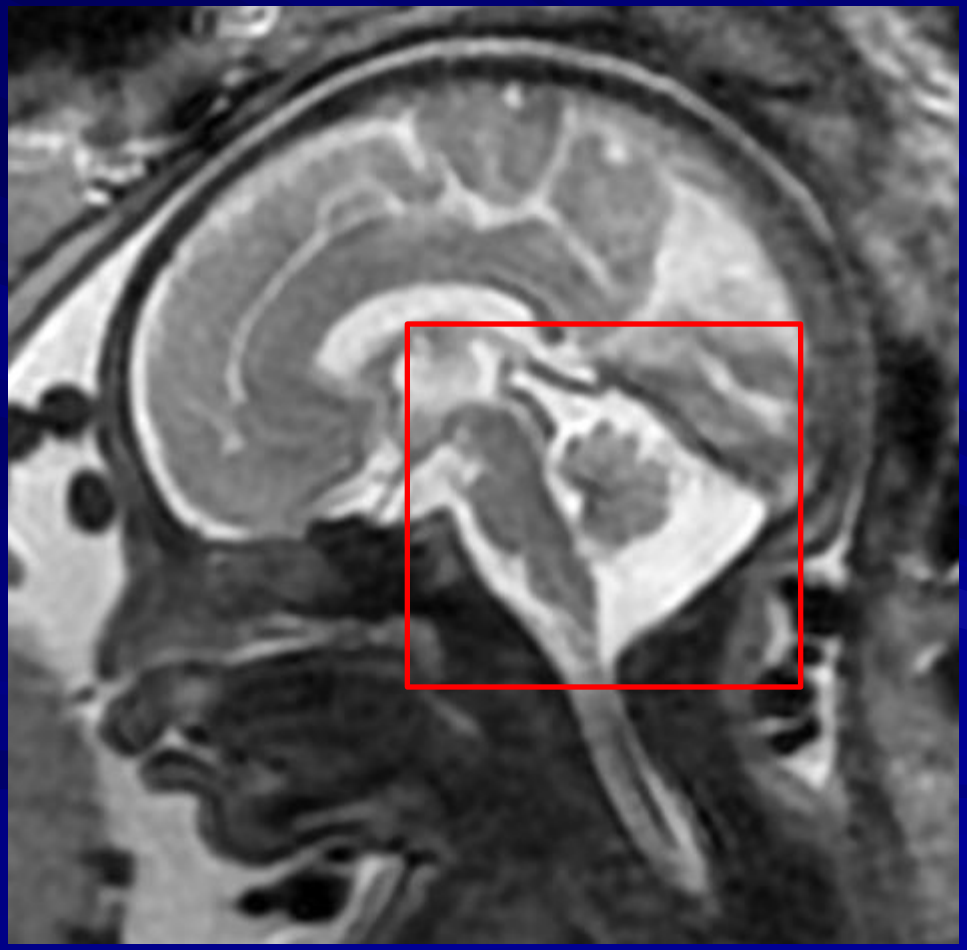
Outline

- ***Overview of the development and malformations of the posterior fossa (PF)***
- ***Diagnosis of posterior fossa malformations***
- ***Measuring new reference data – methods and results***
- ***Possible Clinical Applications***

- ***My experience in the Arrow Project***

Anatomy of the PF

Midsagittal plane



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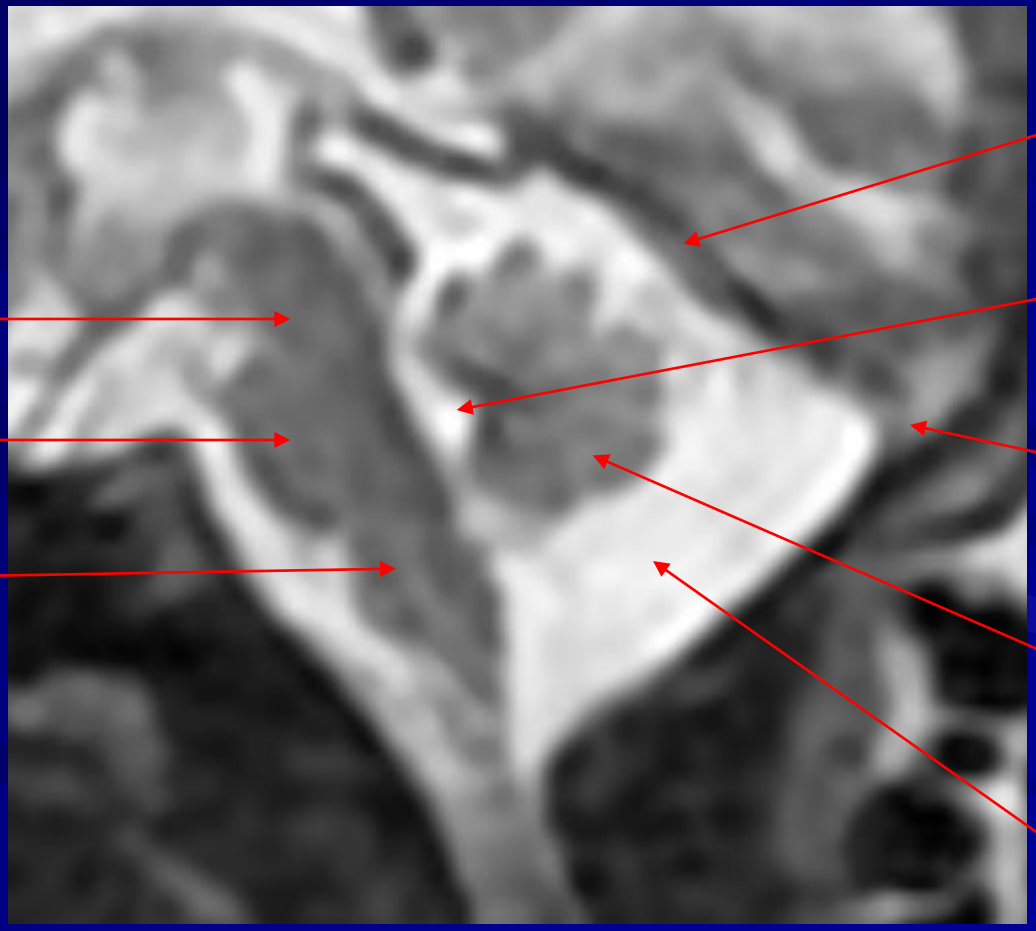


Brain stem

Midbrain

Pons

Medulla oblangata

Tentorium Cerebelli

4th Ventricle

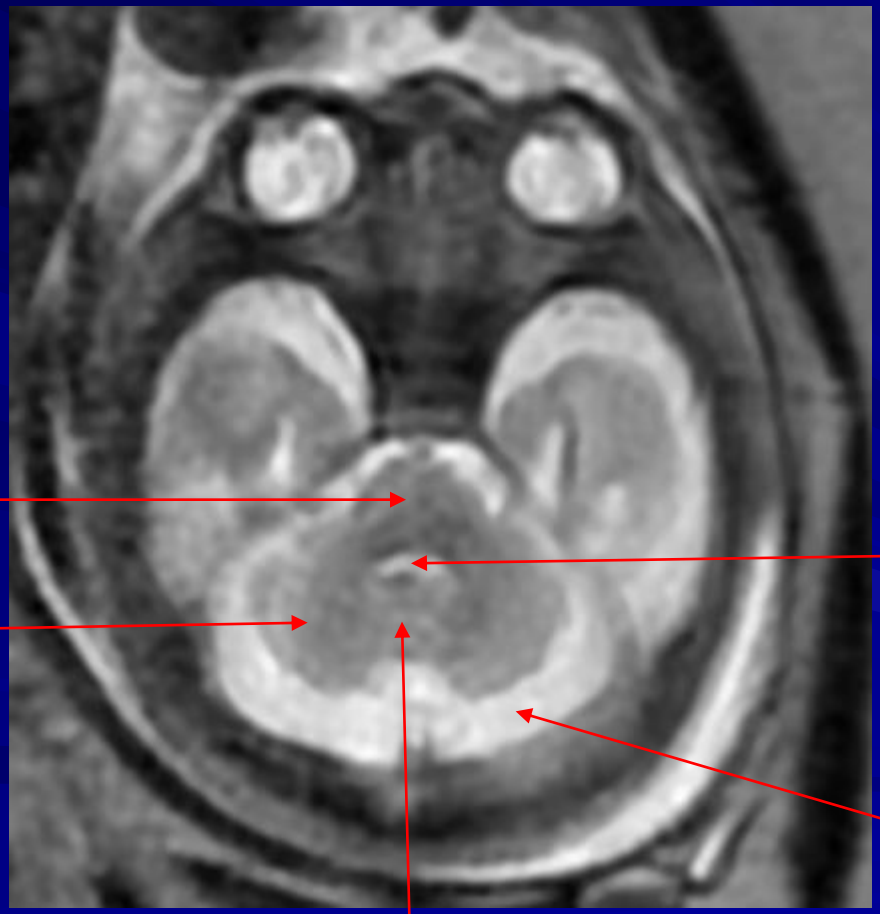
Torcular

Vermis

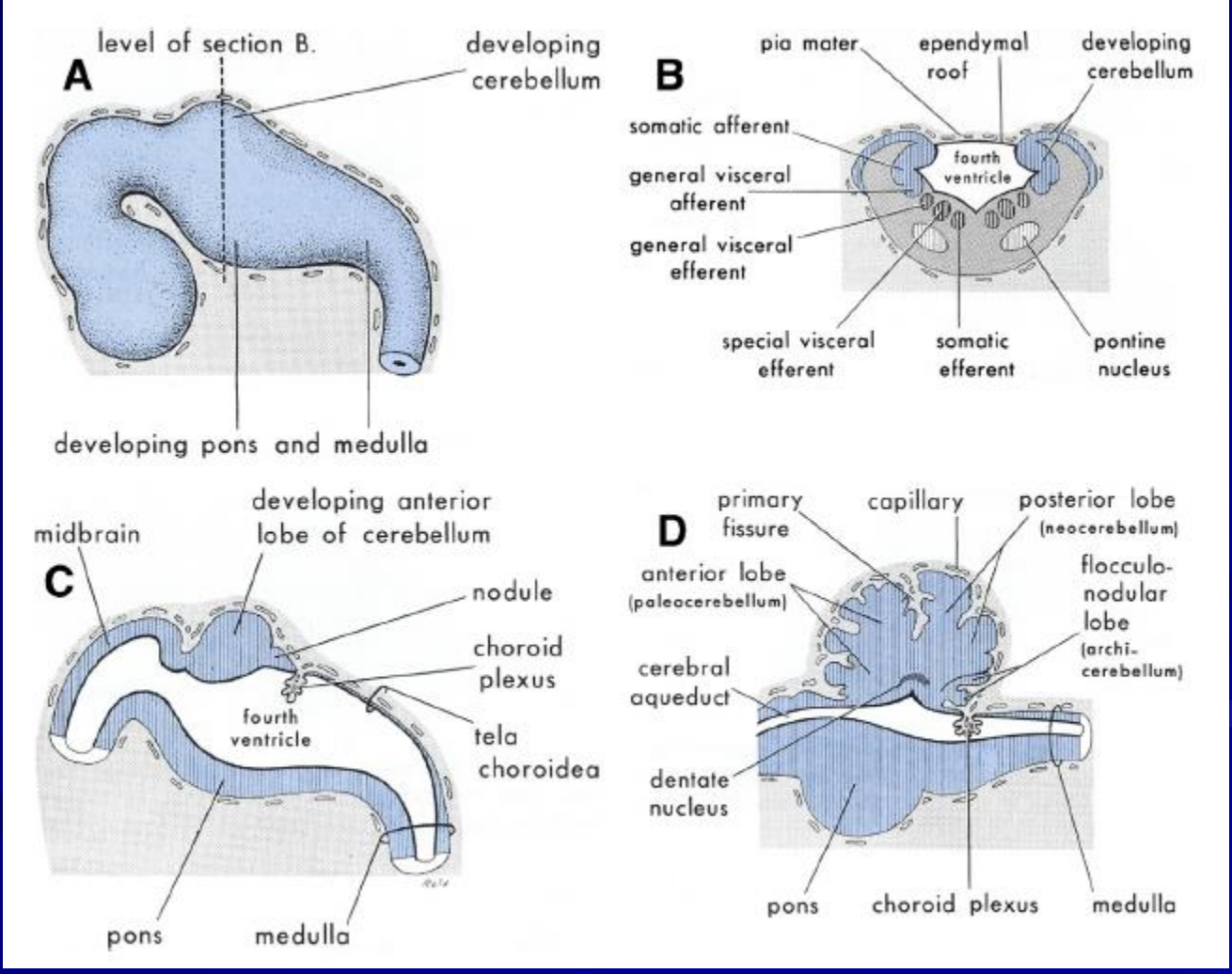
Cisterna Magna (CM)

Anatomy of the PF

Axial plane

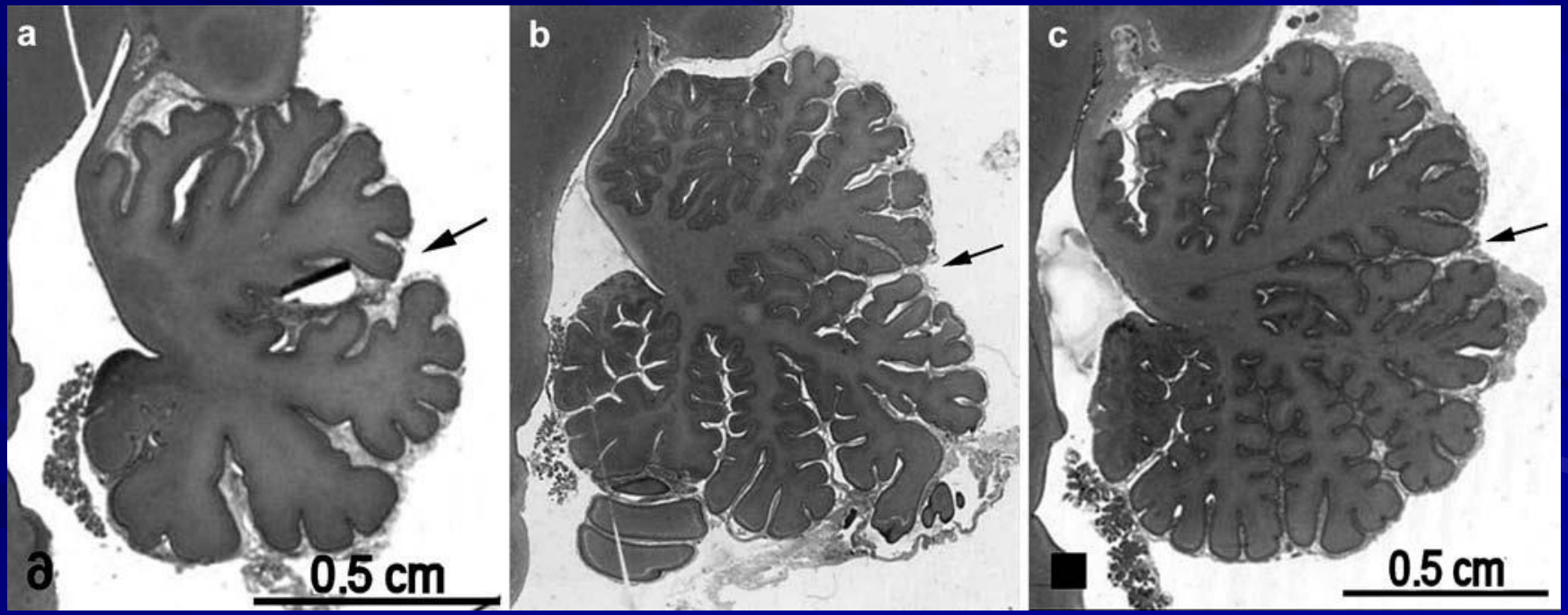


Development of the PF



Development of the Vermis

- Cephal to caudal development of the vermis
- 16th week – full vermis and cerebellum (3 lobes)
- 18th week – 4th ventricle fully covered
- The formation of fissures and lobules continue



22GW 28GW 32GW

PF malformations

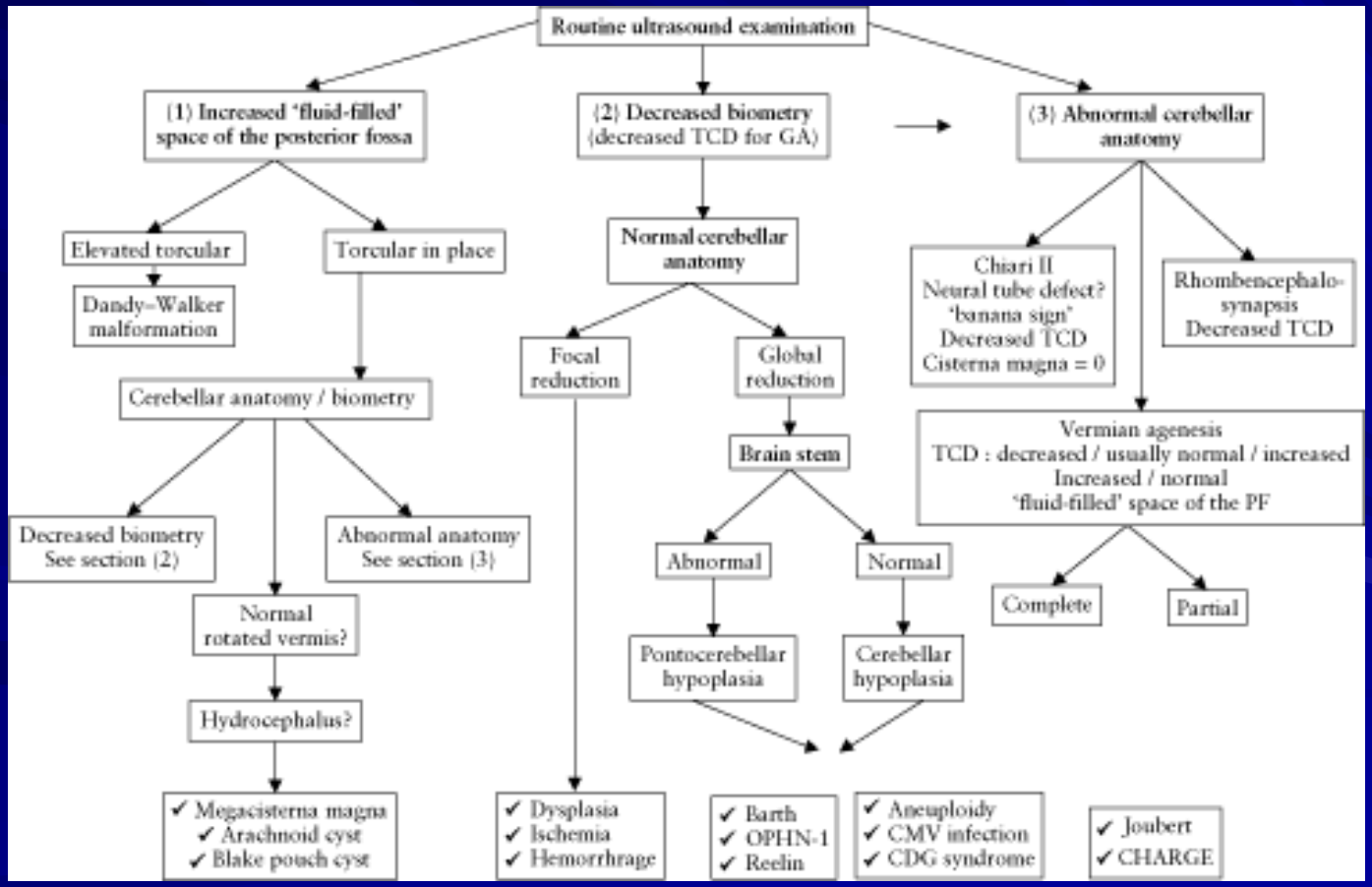
- **A common finding**
- **Broad spectrum of diagnoses and prognoses**
- **No universally acceptable classification:**
  - *Patel and Barkovich (2002):*
    Hypoplasias and displasias
  - *Tortori-Donati* (2005):
    Cystic and non-cystic
  - *Guibaud* (2006):
    Agenesis: Complete or partial absence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

Diagnosis of PF malformations

Plea for an anatomical approach to abnormalities of the posterior fossa in prenatal diagnosis

L. Guibaud and V. des Portes

Ultrasound Obstet Gynecol 2006; **27**: 477–481



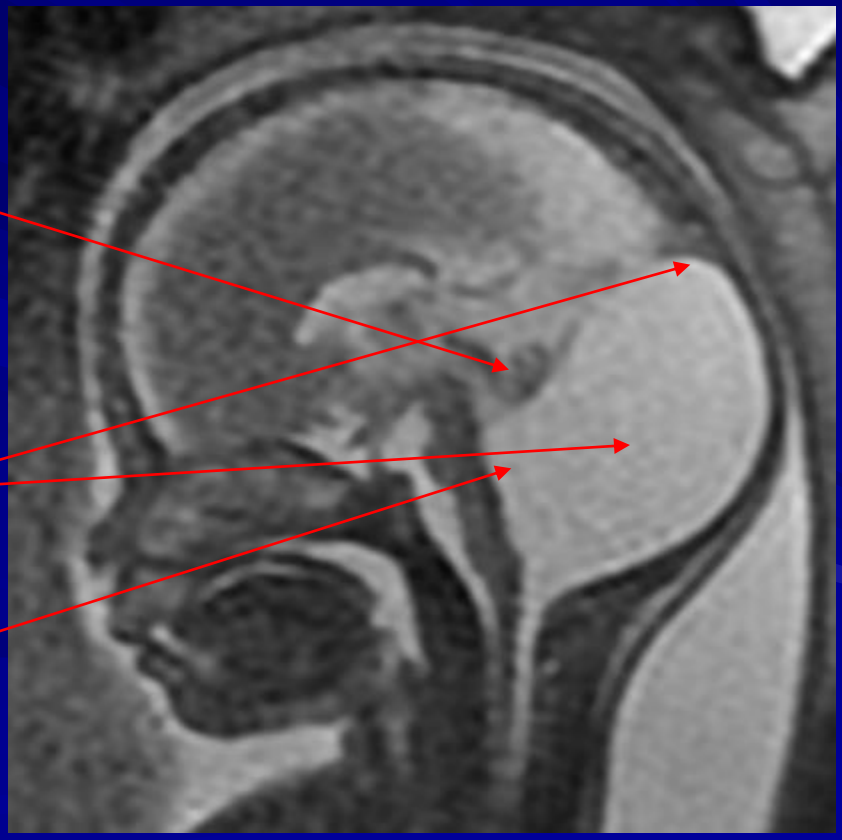
Dandy-Walker malformations

- **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 malformations

- **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…**
  - **Prognosis varies even more**

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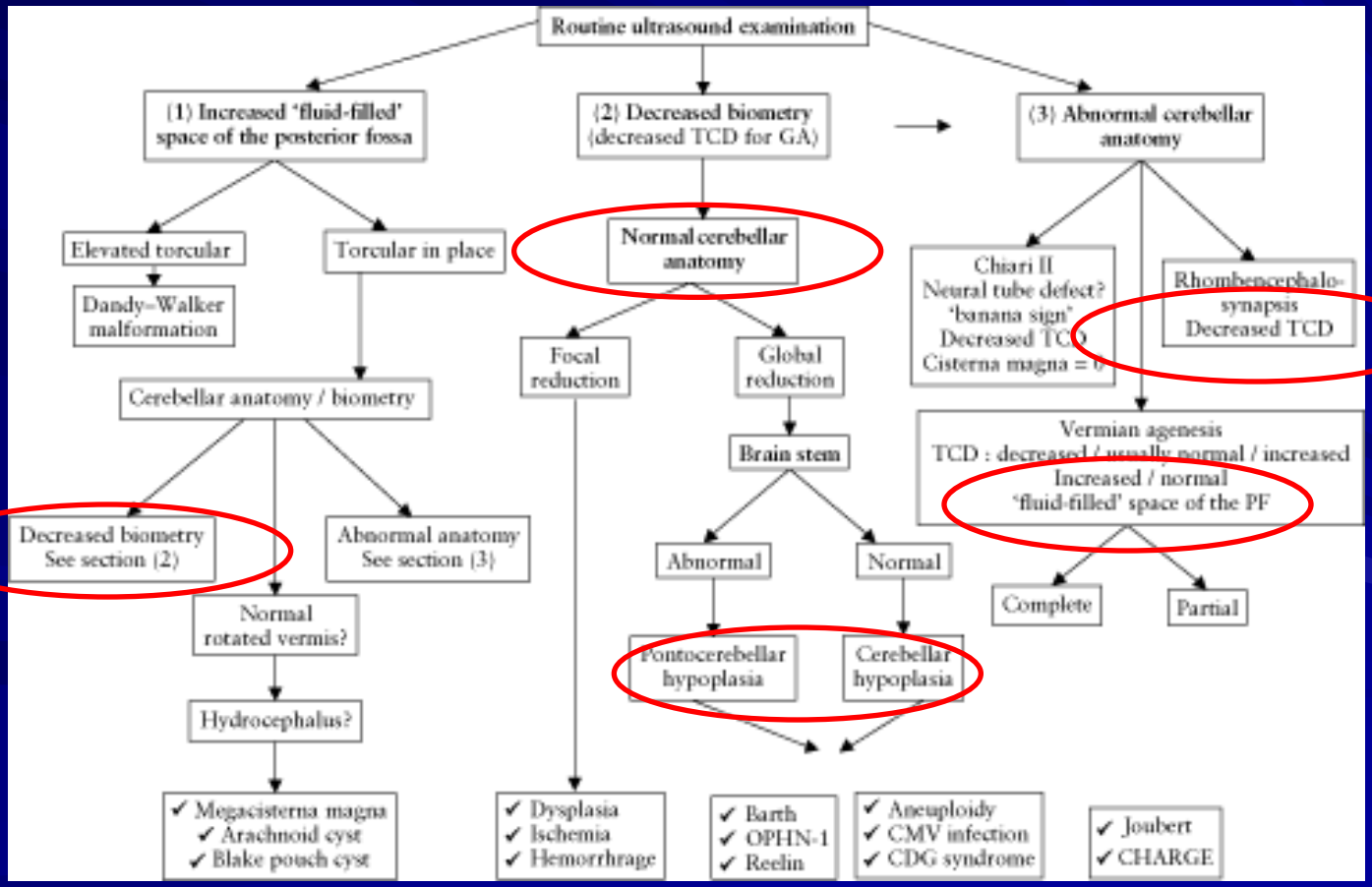
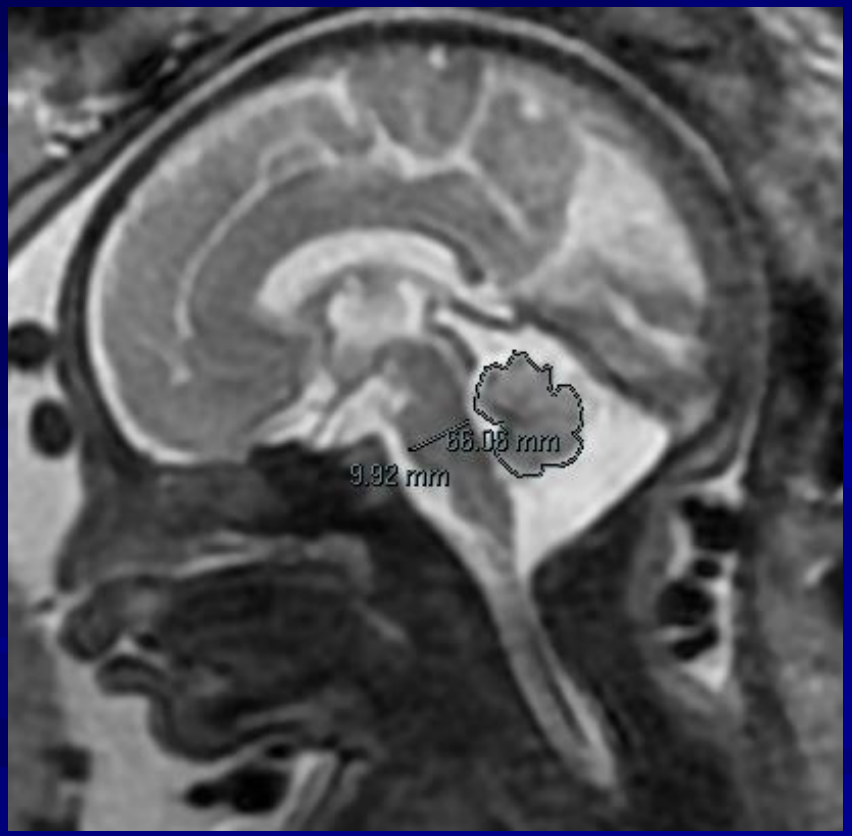


Existing biometric data

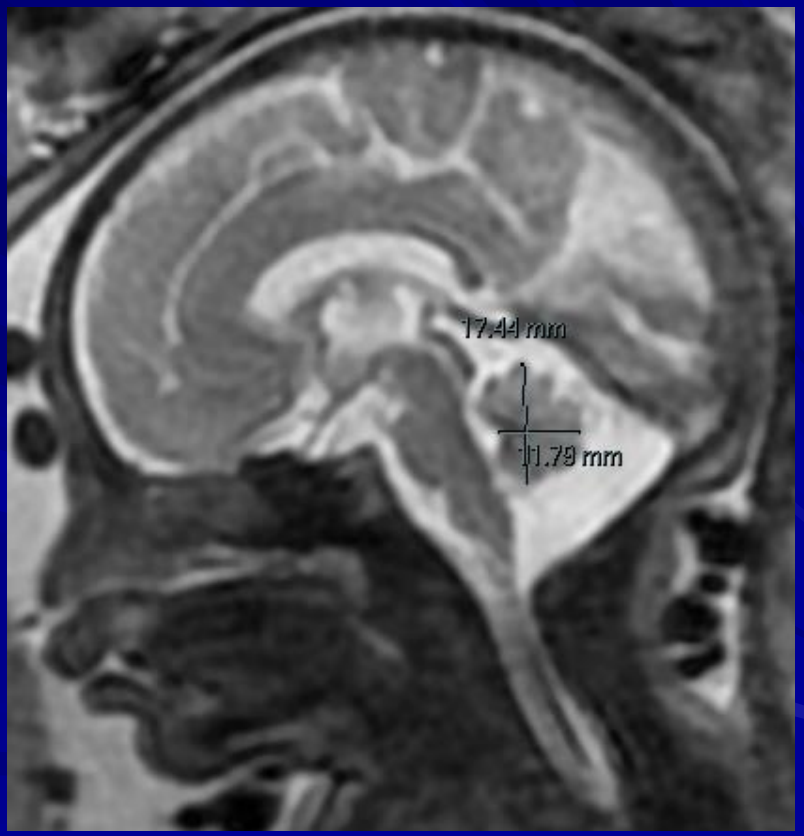
- **US biometry – numerous studies**
- **MRI biometry – comprehensive study by Garel et al.:**
  - **Cohort of 589 normal fetuses**
  - **5 measurements of structures in the PF:**
    - **Vermis: A-P, S-I, cross sectional area (CSA)**
    - **Pons: A-P**
    - **Cerebellum TCD**

Existing biometric data

Vermian CSA, Pons A-P

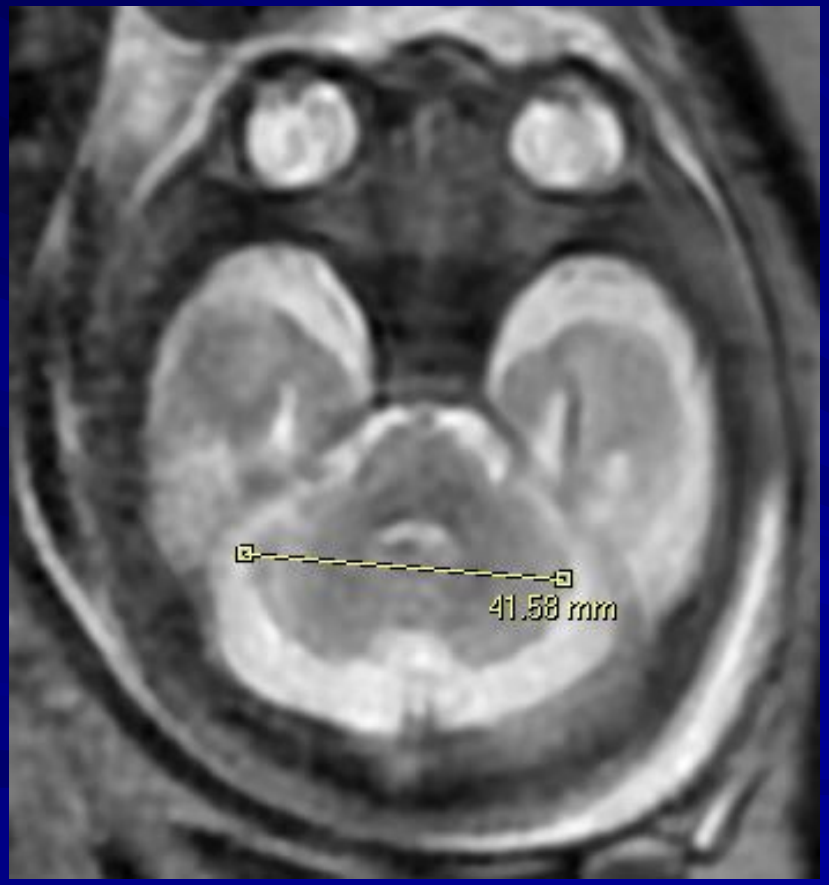


Vermis A-P, Hight



Existing biometric data

TCD

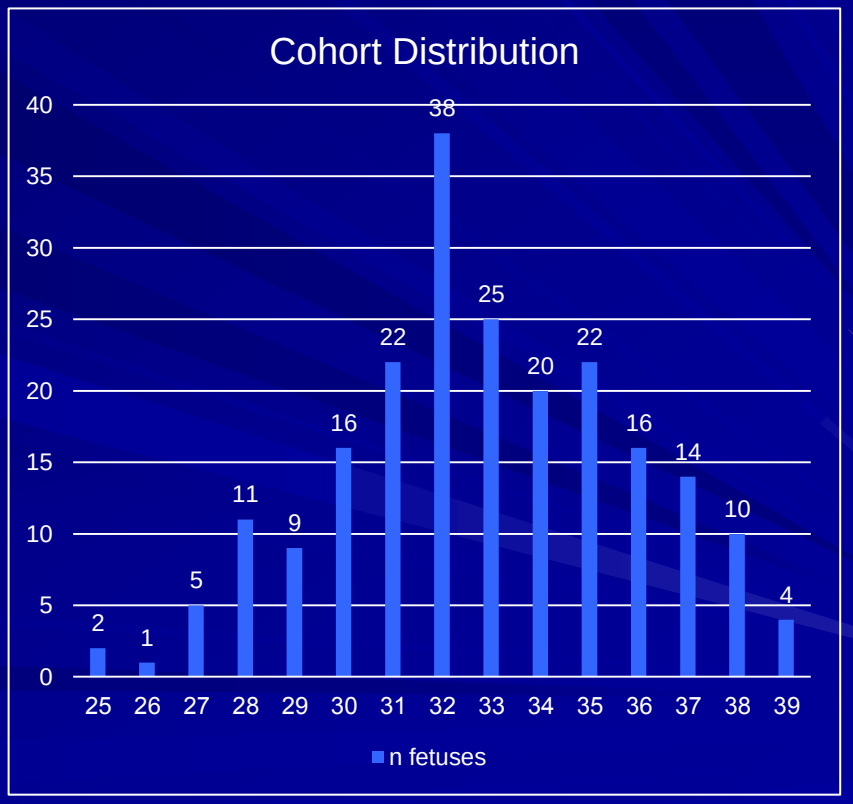


Our Study

- **Objectives:**
  - ***Re-evaluation of existing reference data***
  - ***Evaluation of new biometric reference data***
  - ***Possible clinical applications of this data***

Methods

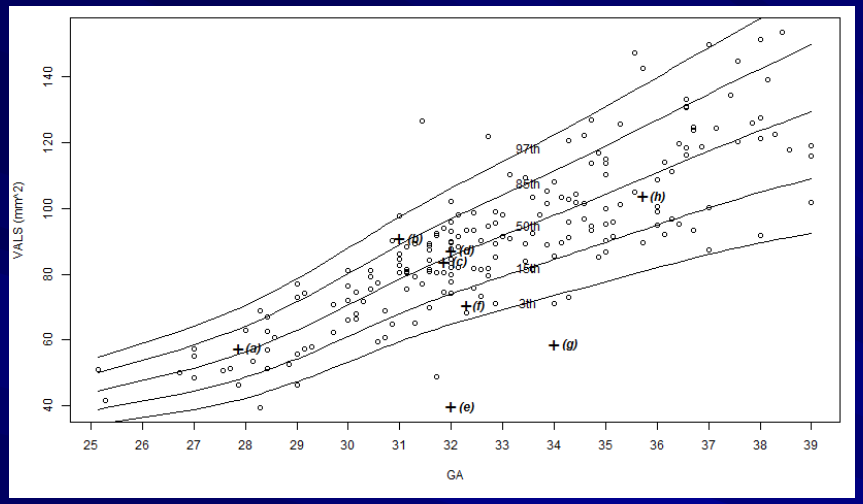
- **Cohort:**
  - **Fetuses with no pathological finding in the posterior fossa, and mild to none pathological finding in the brain**
  - **215 fetuses (151-211)**
  - **GA 25-39 wks**
  - **Indication stats:**
    - **Suspected anomaly 50%**
    - **Maternal CMV infection 23%**
    - **Disorders in the family/ previous pregnancies/ genetic disorders 13%**
    - **Extra-cranial anomalies 10%**
    - **Others**
  - **Finding stats (MRI):**
    - **No intra-cranial findings 80%**
    - **Mild Vent.asymmetry/ Vent.megali 20%**

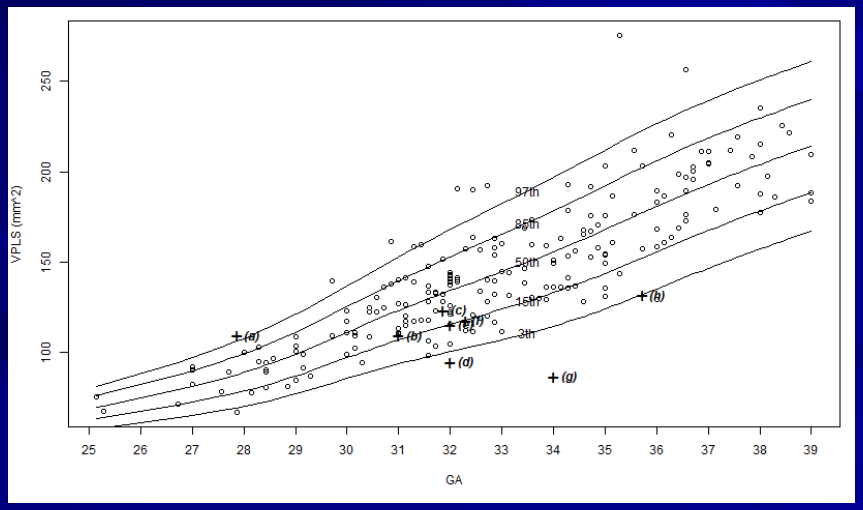


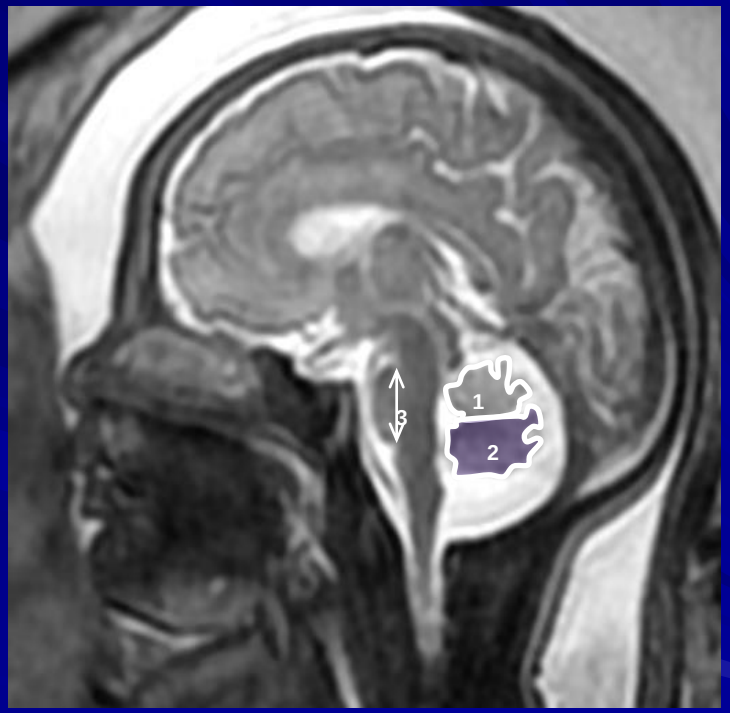
Methods

- **Measurments:**
  - **Brainstem, Cerebellum, Vermis, CM**
  - **Sagittal and axial planes**
  - **5 of existing data**
  - **8 of new reference data**
  - **Relations between structures' biometry:**
    - **Ant/Post vermian lobes (VLR)**
    - **Cerebellar hemispheres (CHR)**
    - **Vermian CSA/ CM CSA (VCMR)**
  - **Inter-observer deviation was calculated**
- **8 cases of pathological fetuses (a-h)**

Results


VALS (mm^2)
GA
97th
85th
50th
15th
3rd
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)


VPLS (mm^2)
GA
97th
85th
50th
15th
3rd
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)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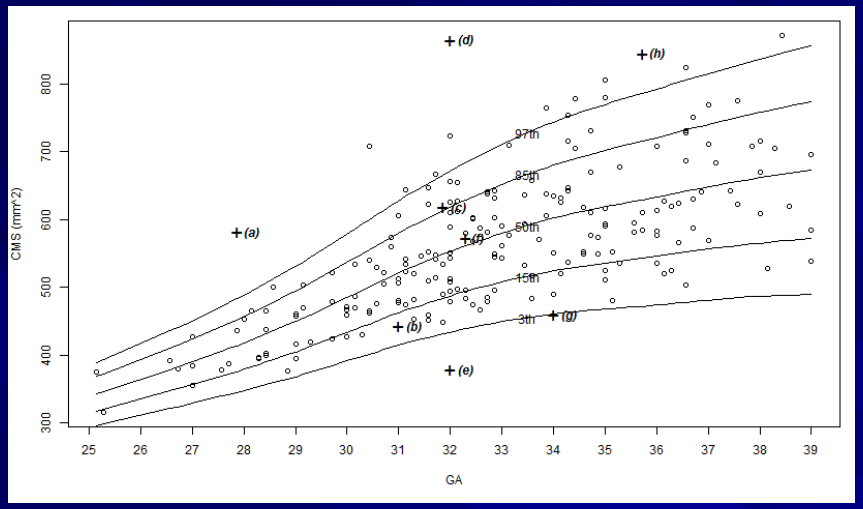
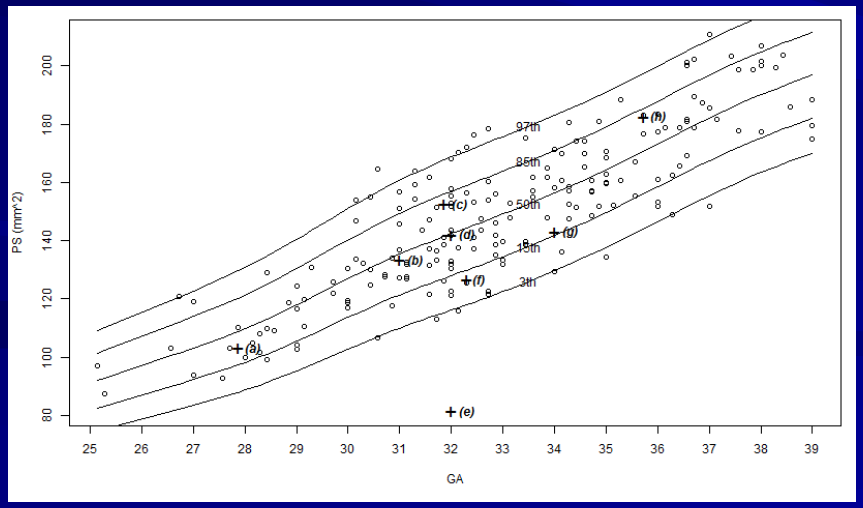
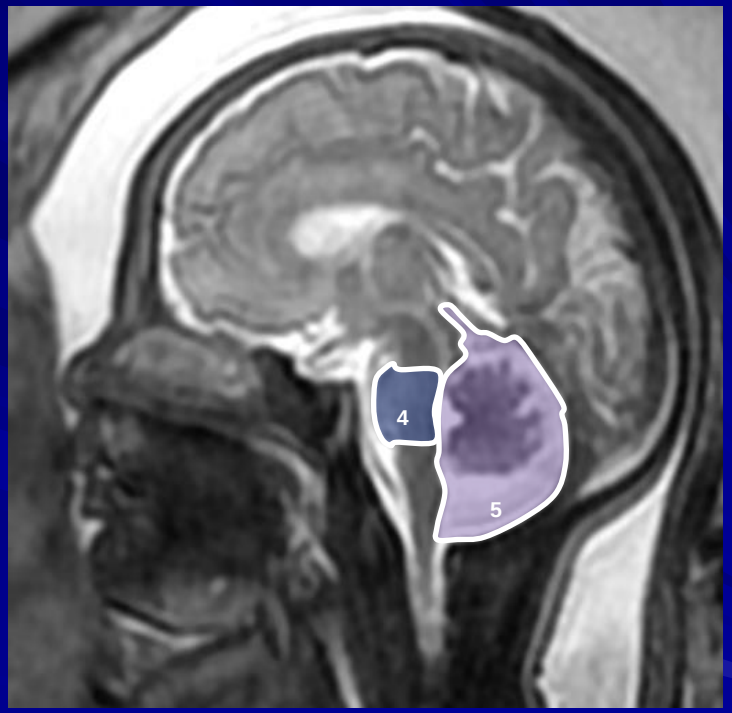
Results


CMS (mm^2)
GA
97th
85th
50th
15th
3th
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)


PS (mm^2)
GA
97th
85th
50th
15th
3th
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)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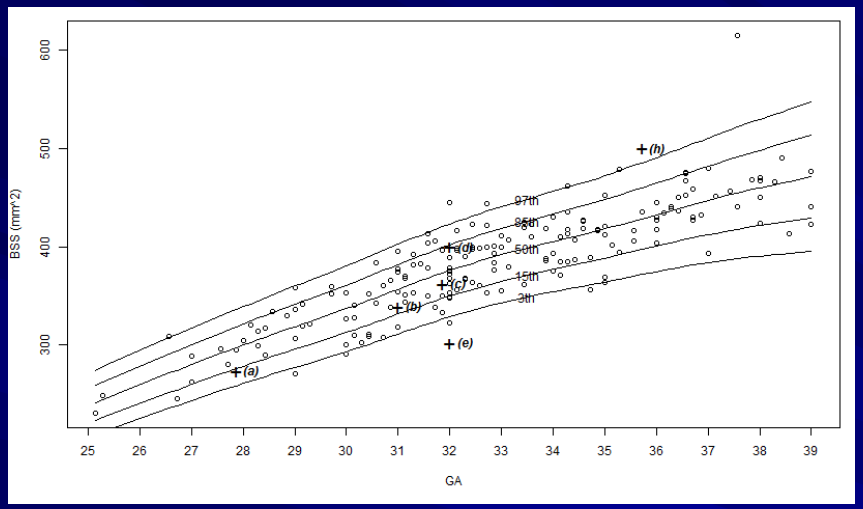
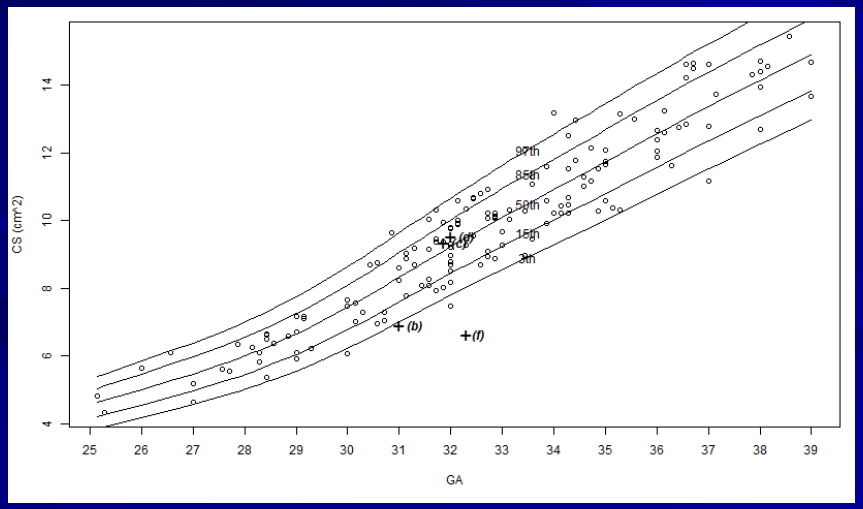
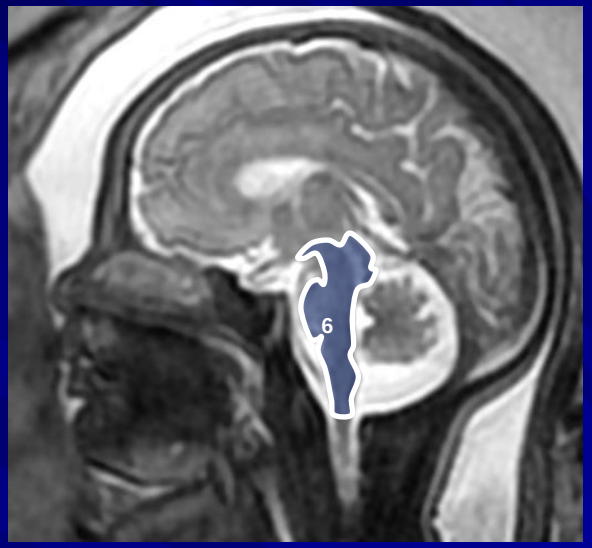
Results


BSS (mm^2)
GA
97th
85th
50th
15th
3rd
(a)
(b)
(c)
(d)
(e)
(h)


CS (cm^2)
GA
97th
85th
50th
15th
3rd
(b)
(c)
(d)
(f)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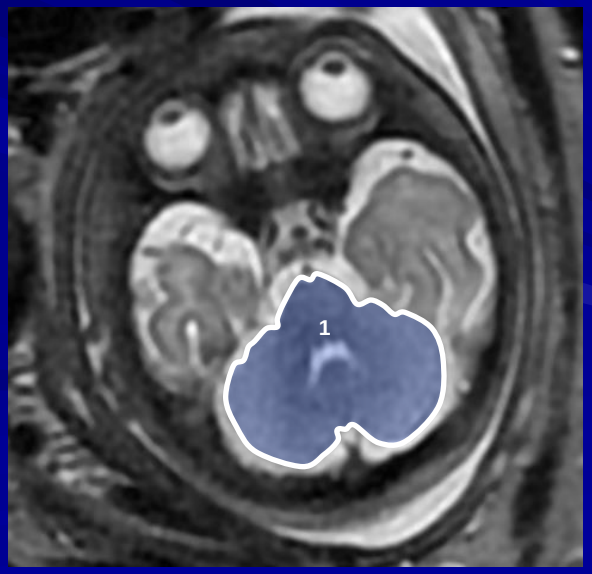
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Results - Interobserver

ICC

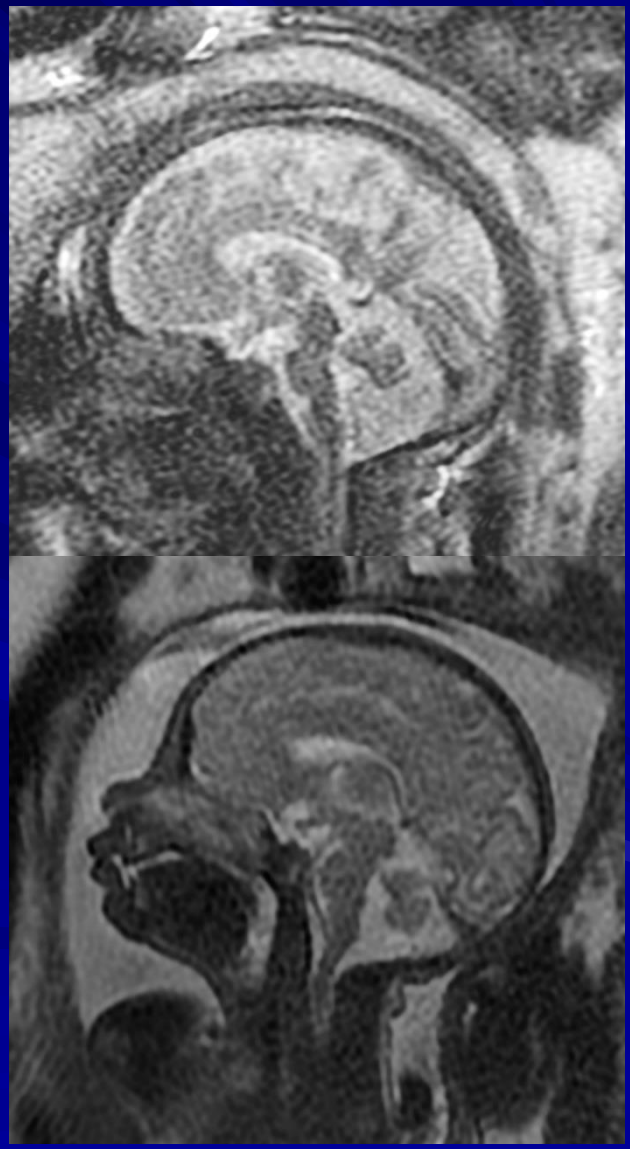
Variable	ICC	95% CI	Mean difference	Std difference	95% LOA
CS (cm^2)	0.983	(0.96,0.99)	0.275	0.371	(-0.45,1)
CP (mm)	0.977	(0.95,0.99)	2.528	2.553	(-2.48,7.53)
TCD (mm)	0.975	(0.94,0.99)	0.867	0.947	(-0.99,2.72)
VH (mm)	0.964	(0.92,0.98)	0.319	0.58	(-0.82,1.46)
CMS (mm^2)	0.96	(0.91,0.98)	-20.434	22.022	(-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)

Possible Clinical Applications

- **Case b:**
  - **Prev. diagnosis: Cerebellar asymmetry**
  - **Average CHR: 1 (p-0.05)**
  - **Normal CHR: 0.88-1.12 (3rd-97th per.)**
  - **Case b CHR: 1.52**
  - **New diagnosis: Cerebellar asymmetry**

Possible Clinical Applications

- **Cases g and d:**
  - **VP, VS below 3rd per.**
  - **Prev. diagnosis: Vermian hypoplasia**
- **Case g:**
  - **VLR normal**
  - **New diagnosis: Complete vermian hypoplasia**
- **Case d:**
  - **VLR above 97th per.**
  - **VALS normal**
  - **New diagnosis: Vermian inf. hypoplasia**
- **Is prognosis different?**



g

d

Possible Clinical Applications

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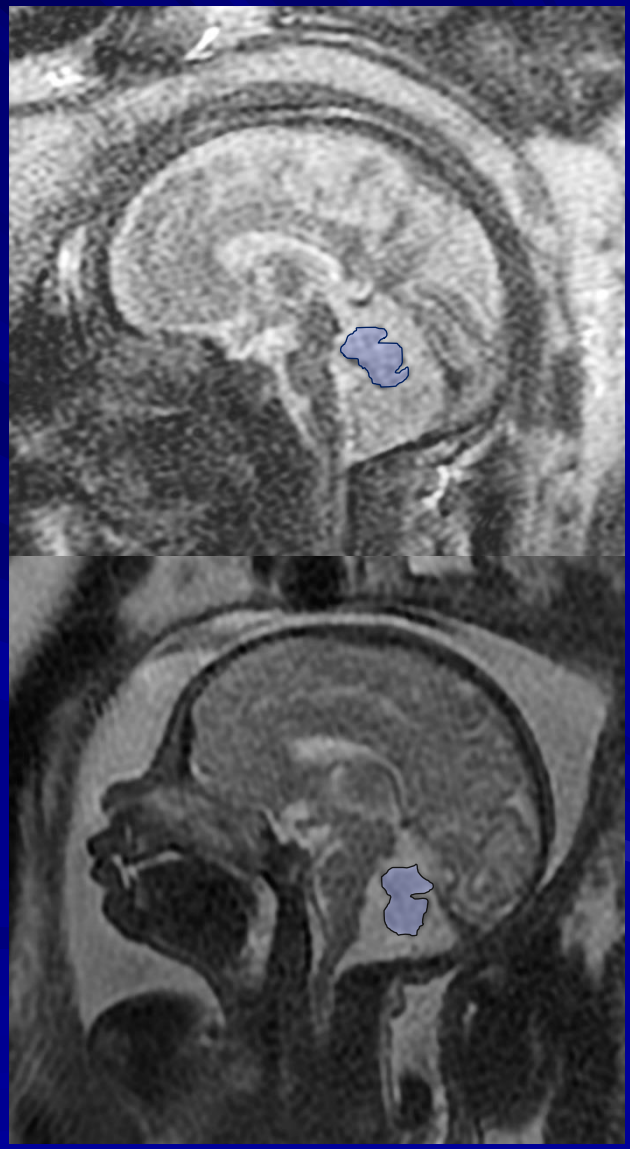

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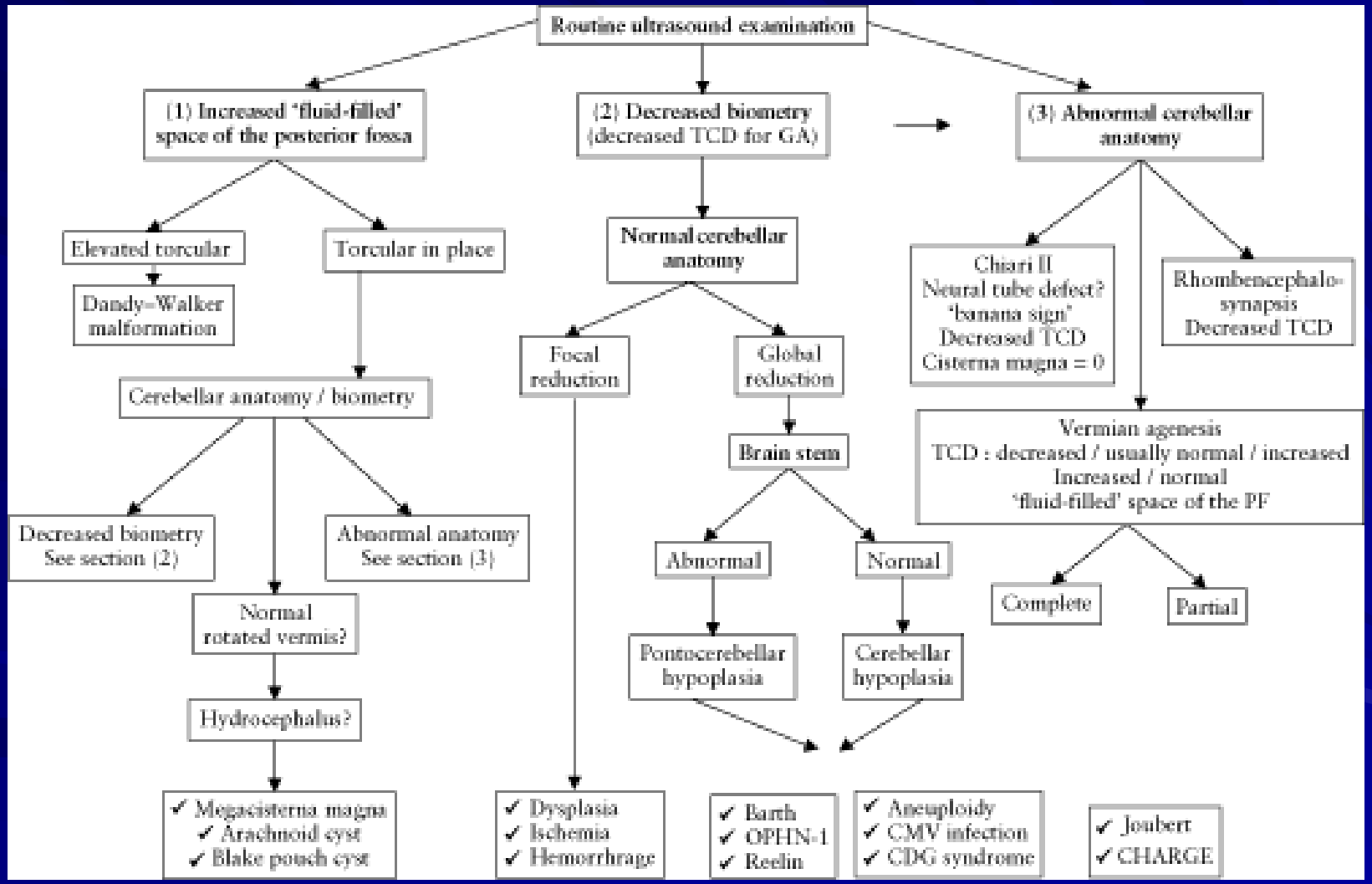
Possible clinical applications



Summary

- **PF malformations - a difficult challenge**
- **Existing biometry – too much left for subjective evaluations**
- **New biometry – objective tool**
- **Next step**
- **Help the patient!**

Thank you