# *Measurements of the Posterior Fossa in Normal Fetus MRI*

**Ber Roee,** *3rd year medical student, Sackler School of Medicine, Tel Aviv University*
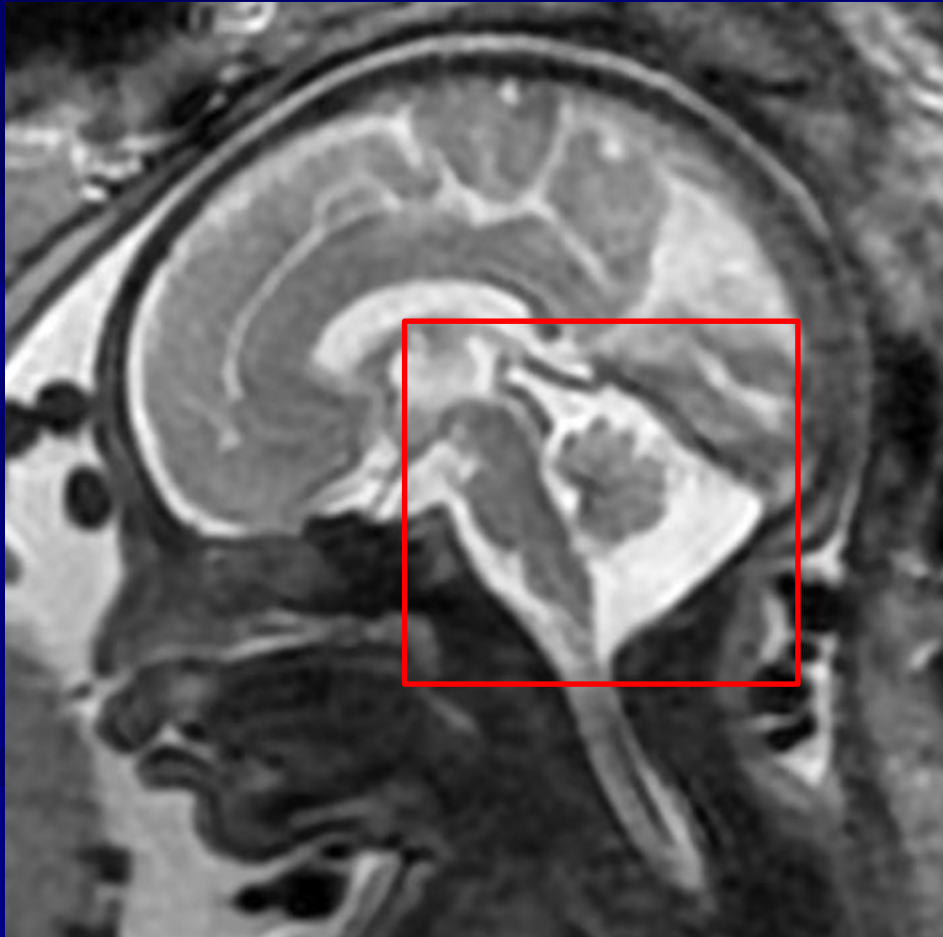
*Supervised by:*
**Dr. Katorza Eldad**, *Antenatal Diagnostic Unit,The Chaim Sheba Medical Center, Tel Hashomer, and Sackler School of Medicine, Tel Aviv University*

# Outline

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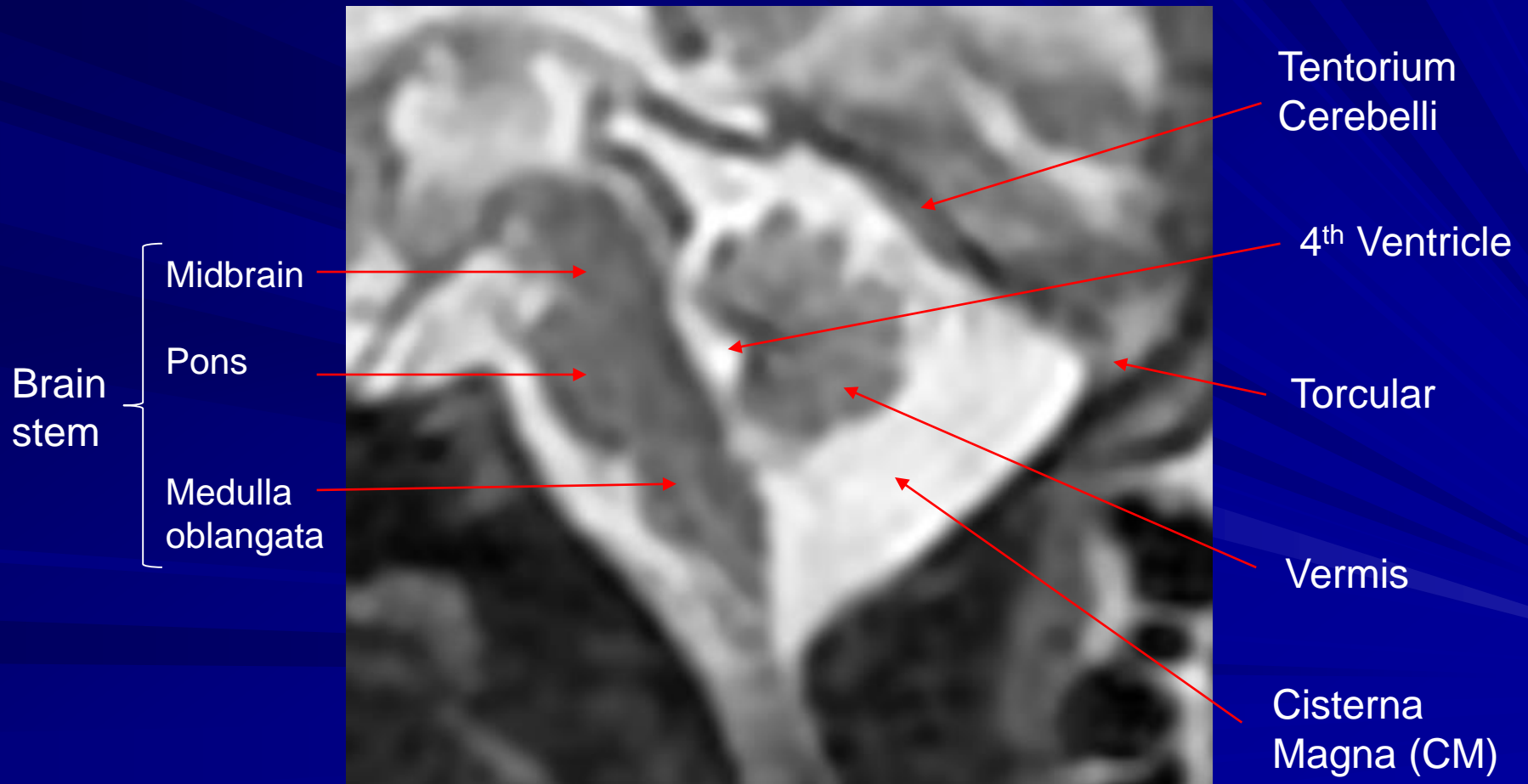- *Possible Clinical Applications*
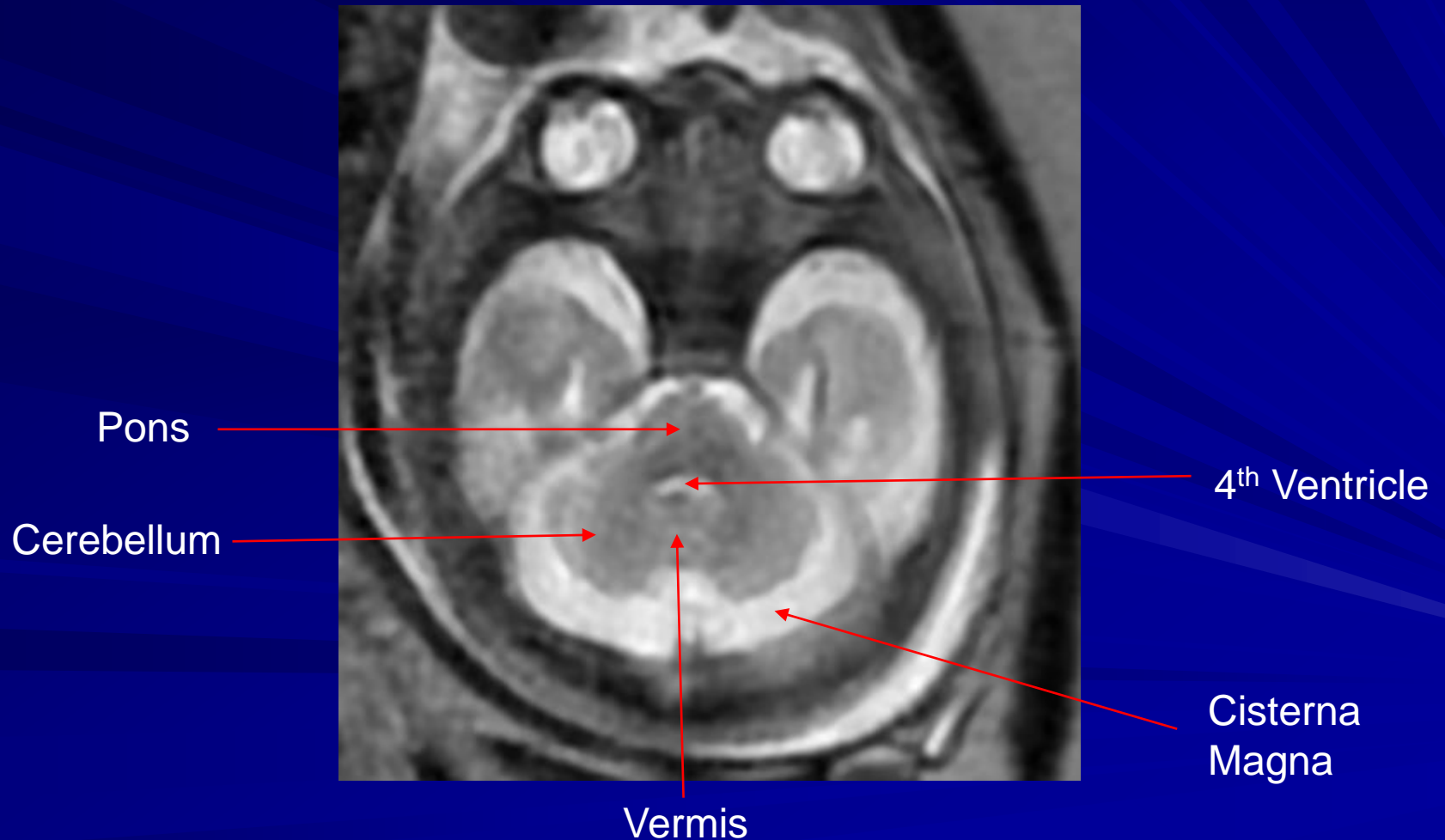
# Anatomy of the PF

Midsagittal plane
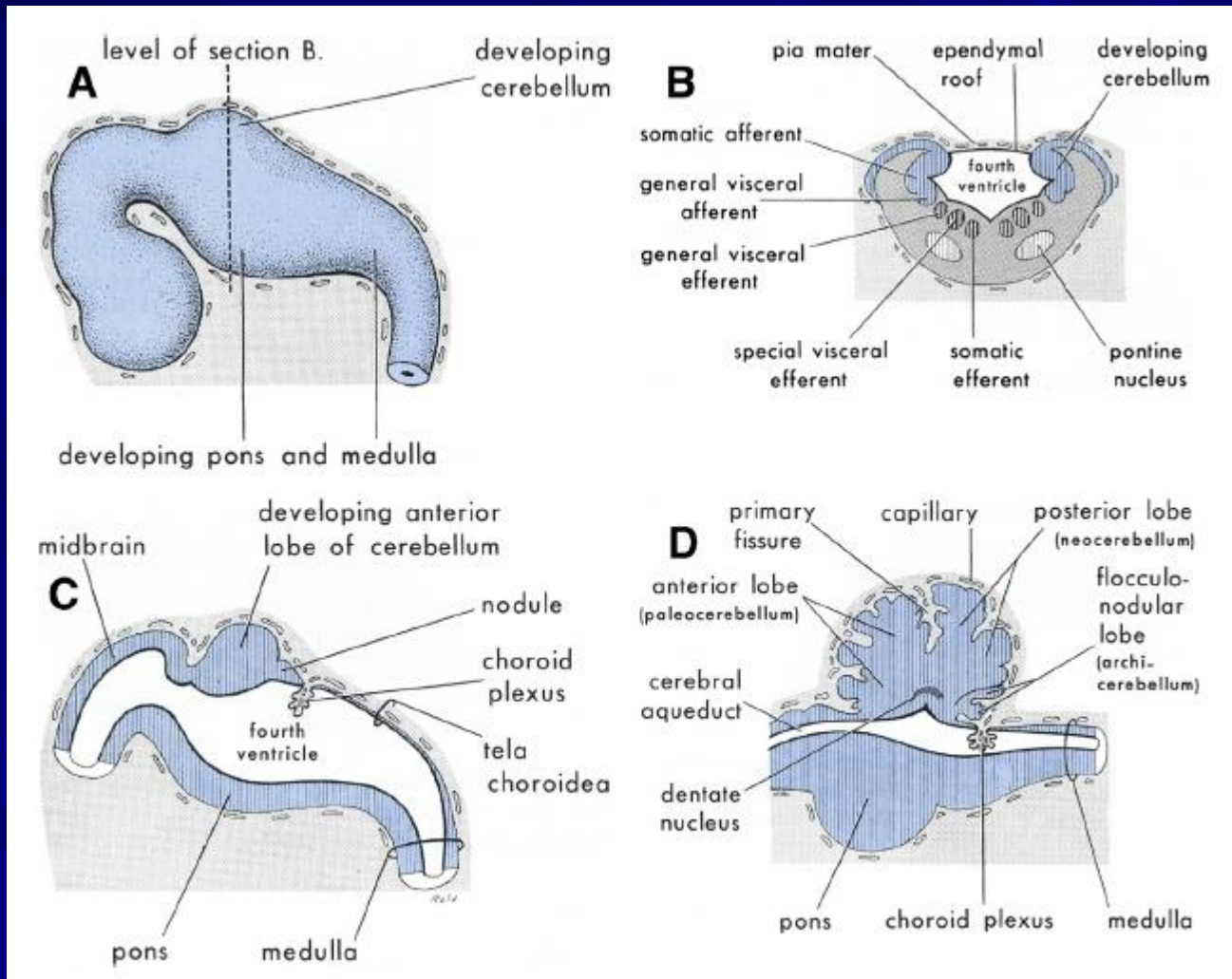
# Anatomy of the PF

Midsagittal plane



Brain stem
- Midbrain
- Pons
- Medulla oblangata

Tentorium Cerebelli

4th Ventricle

Torcular

Vermis

Cisterna Magna (CM)

# Anatomy of the PF

Axial plane



Pons

Cerebellum
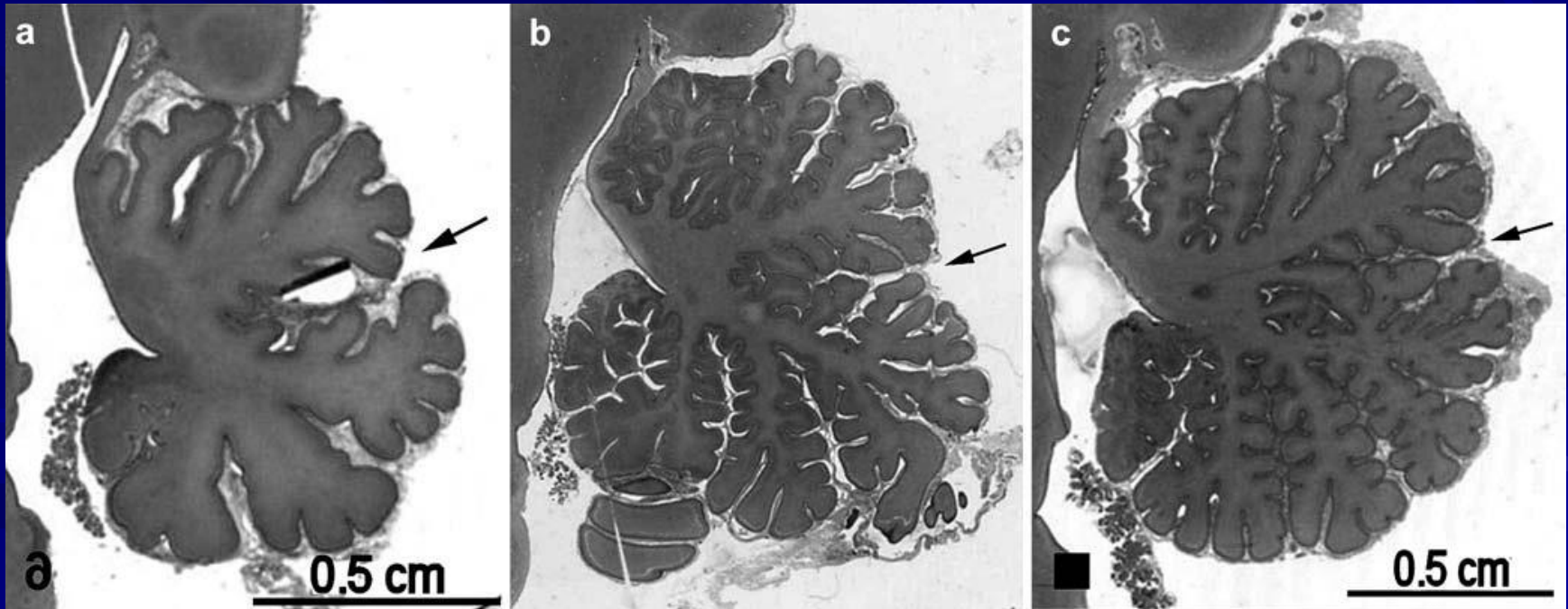
4<sup>th</sup> Ventricle

Cisterna Magna

Vermis

# 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
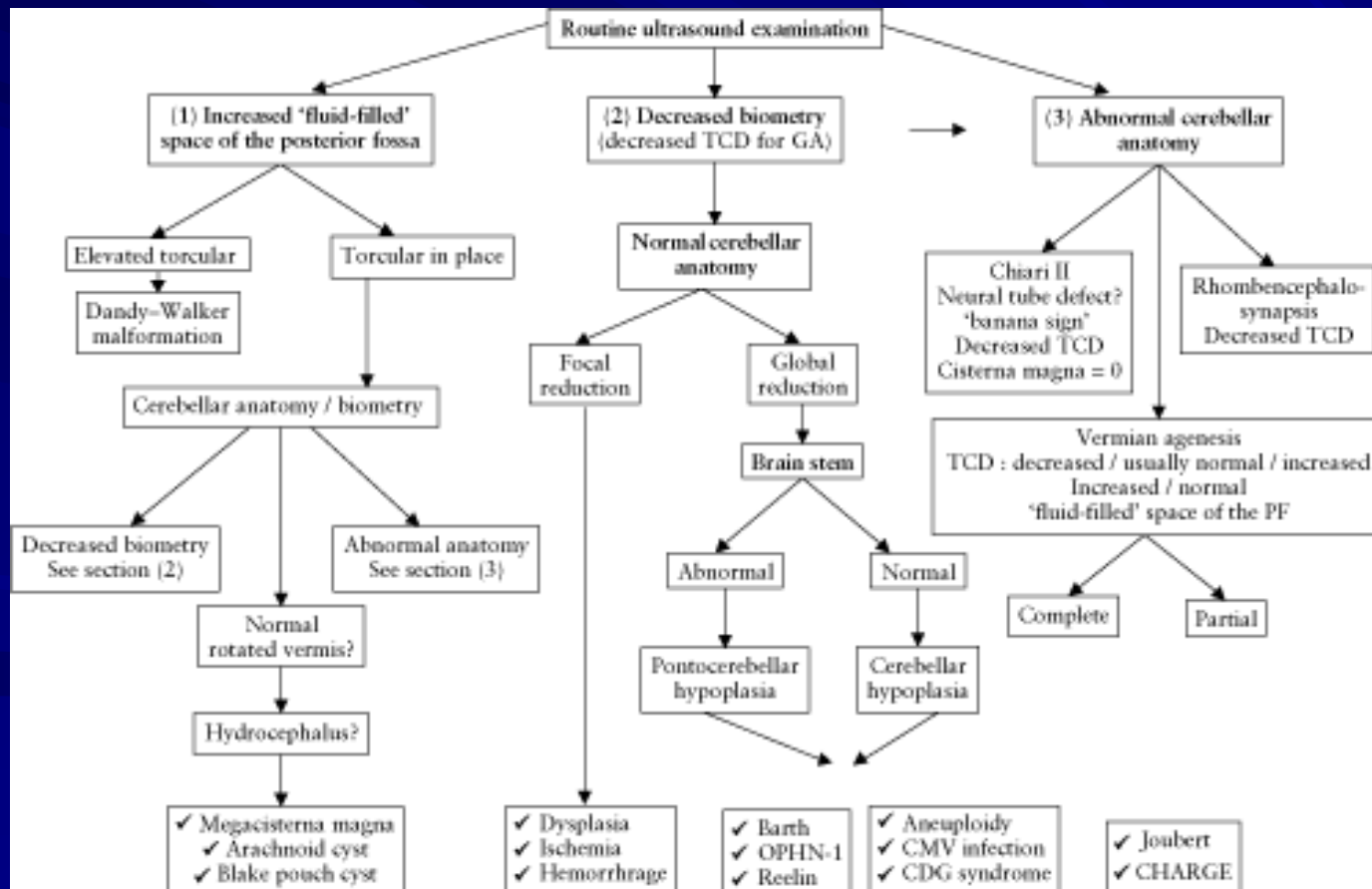
# PF malformations

- **Abnormal PF takes a major part in fetal brain abnormalities**

- **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)**
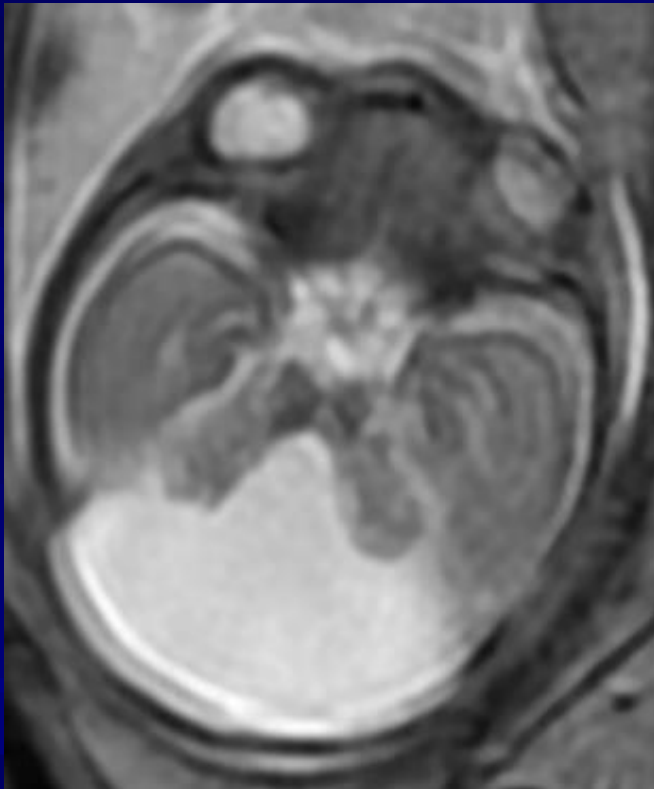- ***The classic triad:***

*Complete/partial vermian agenesis*

*Enlarged PF with upward displacement of the tentorium and the torcular*
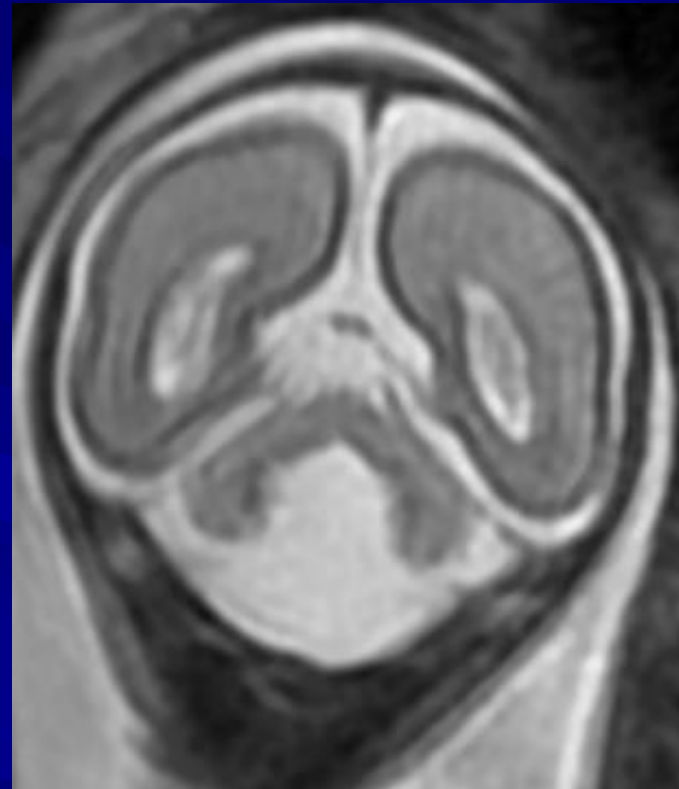
*Cystic dilation of the 4th ventricle*

# Dandy-Walker malformations

**Axial**

**Coronal**
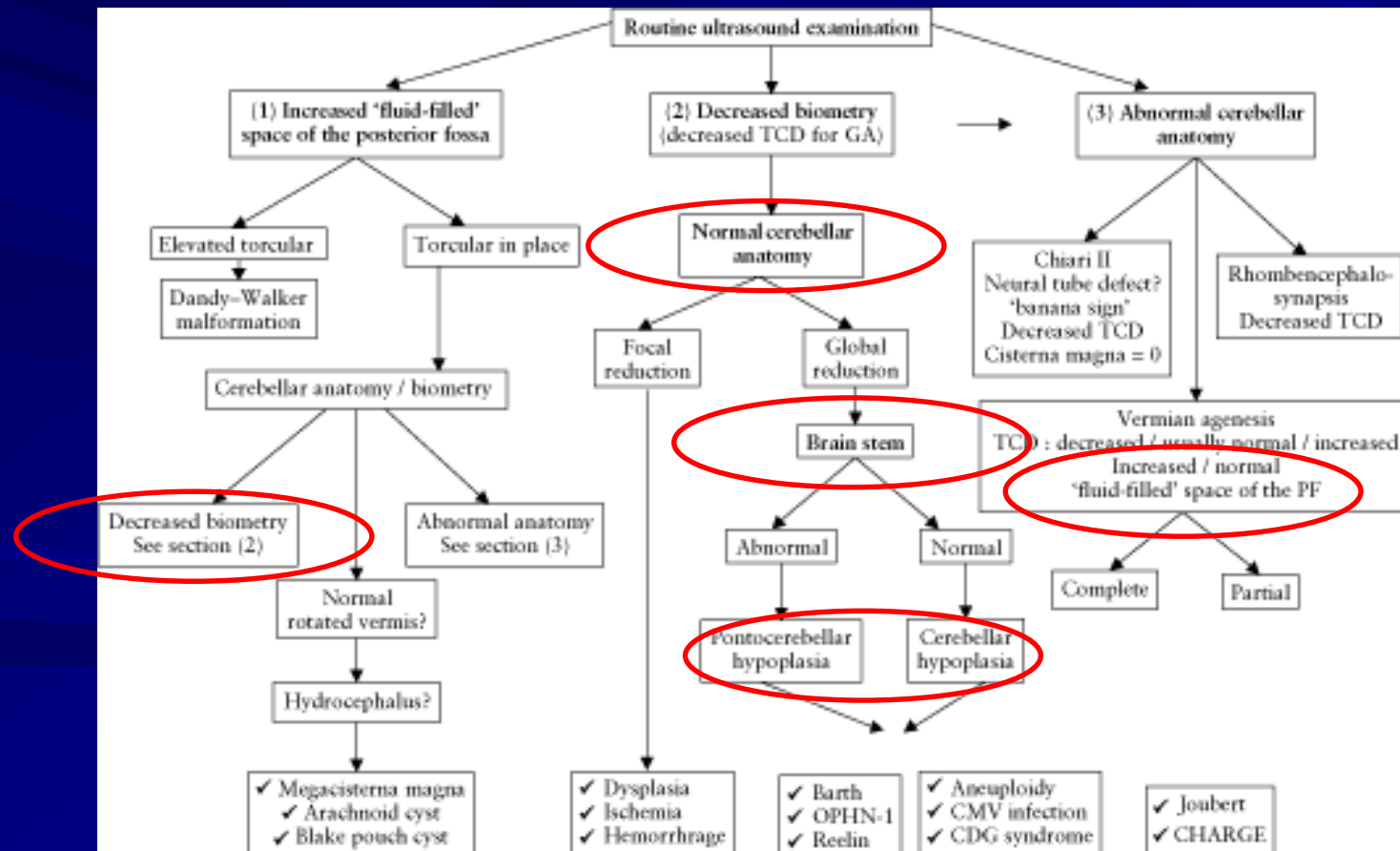
# Dandy-Walker malformations

- **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 pouch, Arachnoid cyst, Mega CM**
  - **Without enlargement of the CM: Dysplasia, infections, ischemia…**
  - **Prognosis vary even more**

# Diagnosis of PF malformations

# Existing biometric data

- **Comprehensive study by Garel et al.:**
  - **Cohort of 589 fetuses**
  - **5 measurments of structures in the PF:**
    - **Vermis: A-P, S-I, cross sectional area (CSA)**
    - **Pons: A-P**
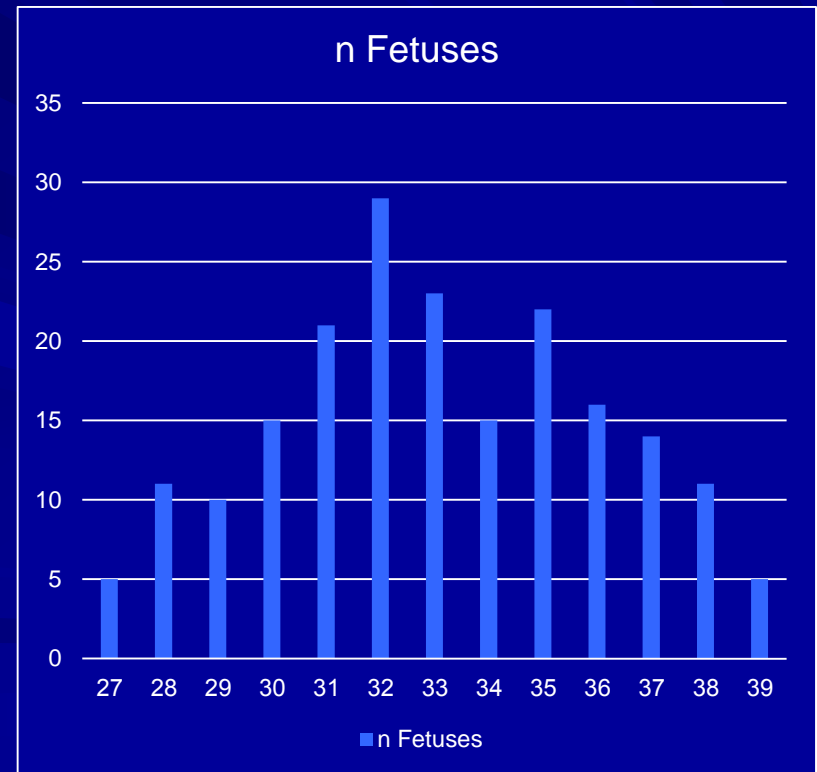    - **Cerebellum TCD**

# New reference data

- **Objectives:**
  - *Re-evaluation of normal MRI existing reference data of fetal posterior fossa, and evaluation of new reference data of normal MRI of fetal posterior fossa*

# Methods

- **Cohort:**
  - Fetuses with no pathological finding in the posterior fossa, and mild to none pathological finding in the brain
  - 200 fetuses
  - GA 27-39 wks
  - Indication stats:
    - CMV infection 25%
    - Ventricular asymmetry 25%
    - Disorders in the family/ previous pregnancies 8%
    - Extra-cranial anomalies 8%
    - Others
  - Finding stats (MRI):
    - No finding 80%
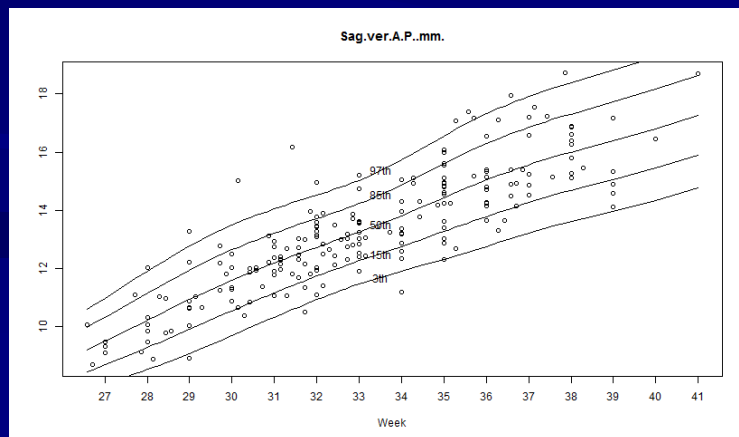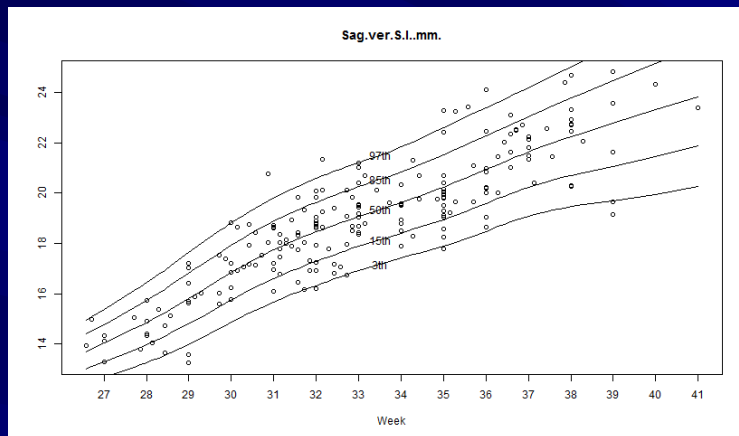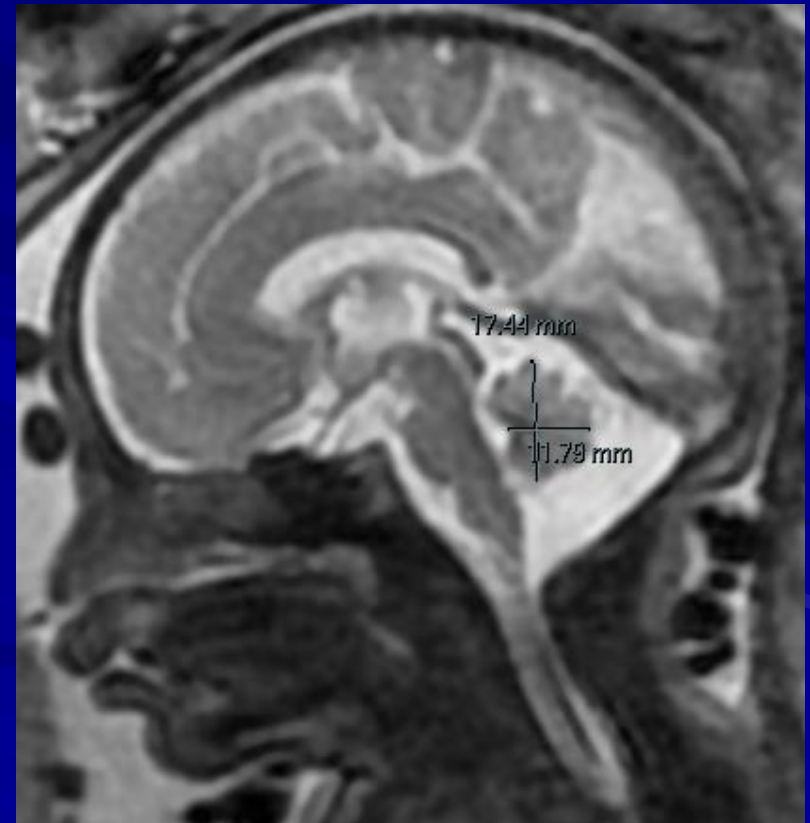    - Mild Vent.asymmetry 20%

# Methods

- **Measurments:**
  - Brainstem, Cerebellum, Vermis, CM
  - Sagittal and axial planes
  - 5 of existing data
  - 12 of new reference data
  - Relations between structures' biometry:
    - Ant/Post vermian lobes
    - Cerebellar hemispheres
    - CM CSA – Vermian CSA = fluid filled space
  - Inter-observer deviation will be calculated

# Measurements of the Posterior Fossa
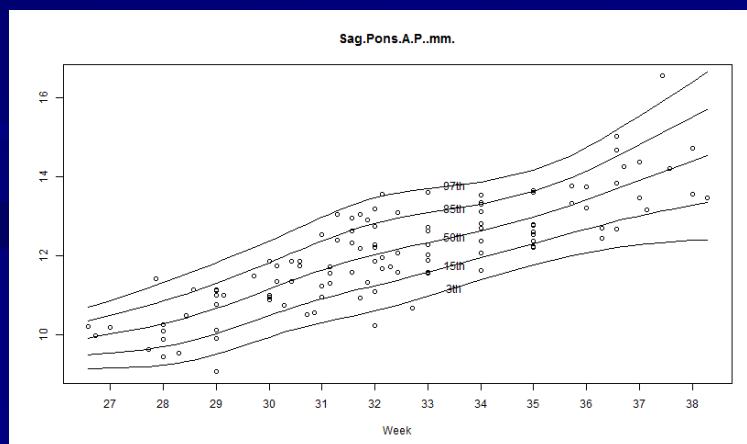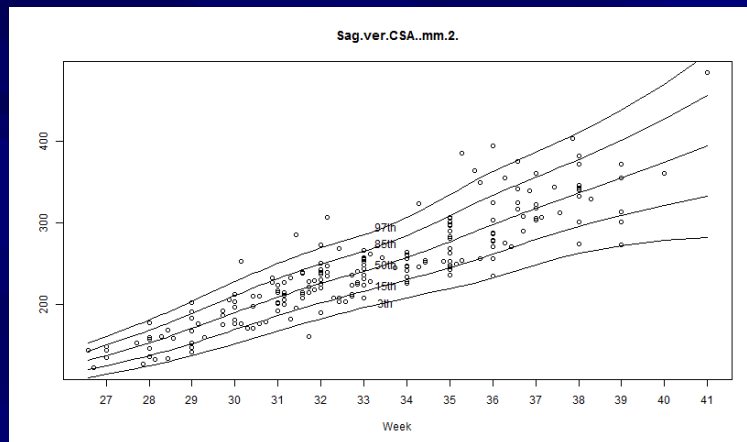
Measurements of existing reference data
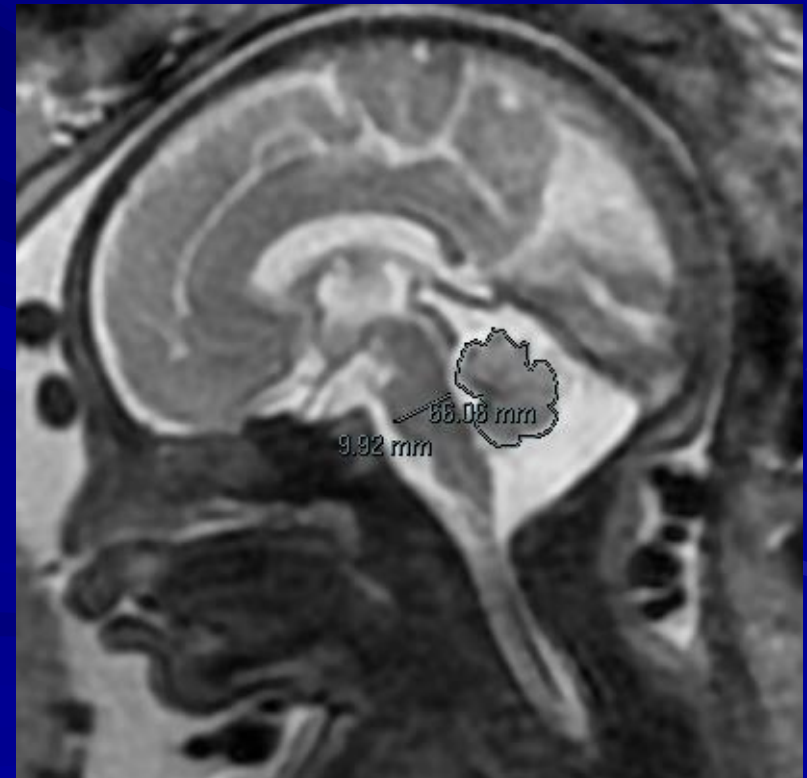


**Vermis A-P, S-I**

# Measurements of the Posterior Fossa
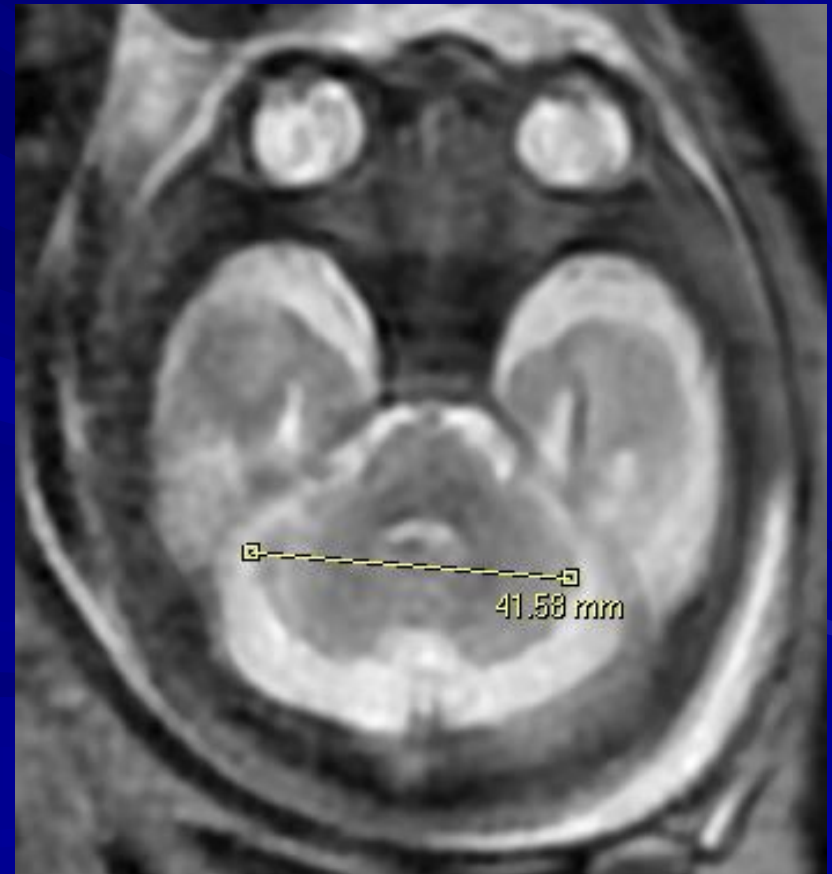
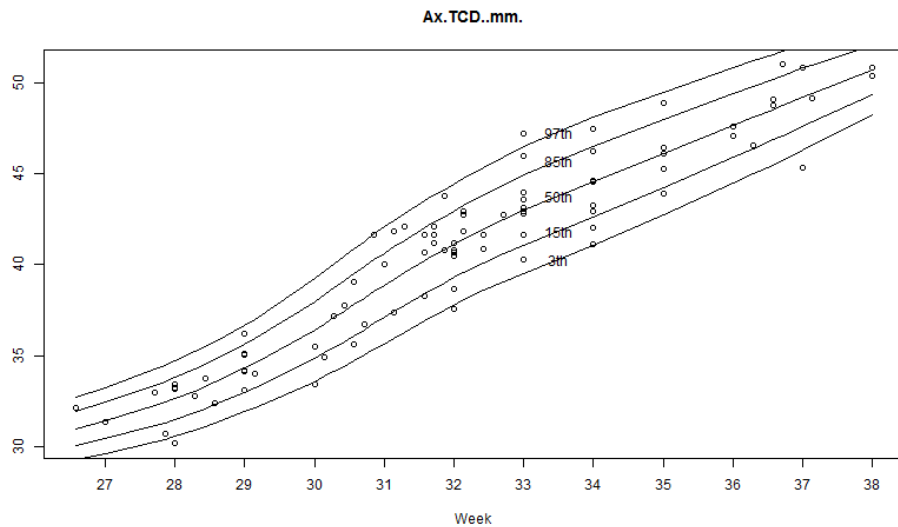## Measurements of existing reference data





**Vermian Perimeter and CSA, Pons A-P**

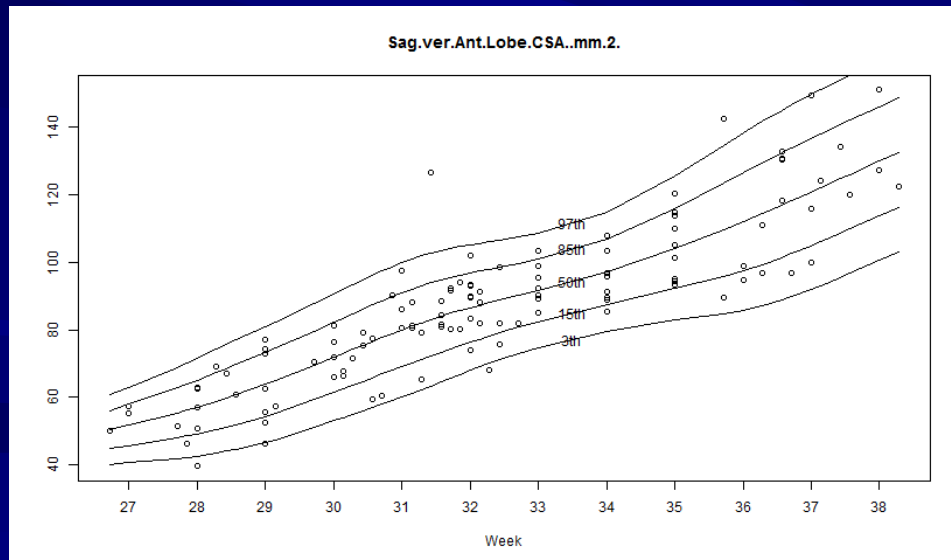# Measurements of the Posterior Fossa

Measurements of existing reference data



TCD

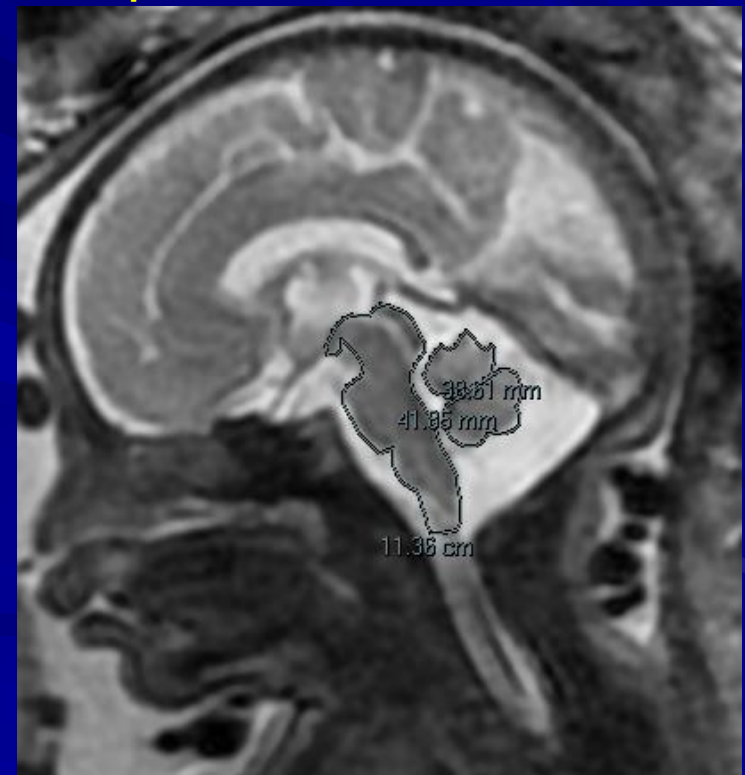# Measurements of the Posterior Fossa

## Measurements of new reference data

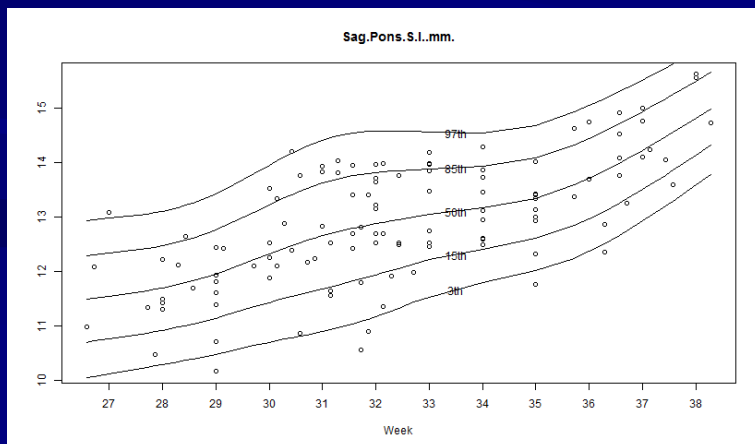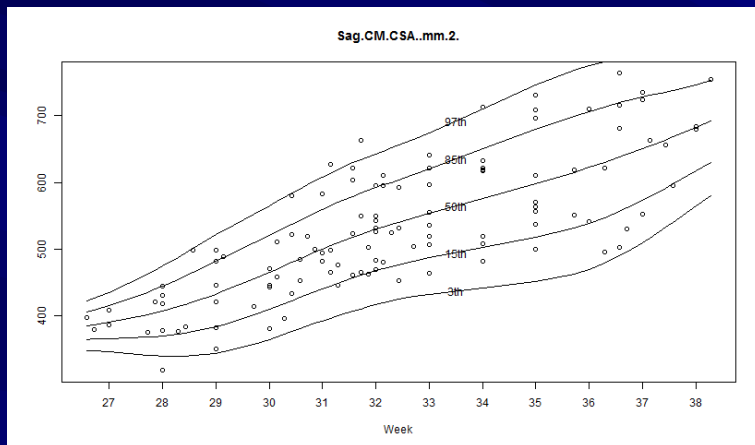| Ant./post. Lobe CSA | | | | |
|---|---|---|---|---|
| 0.03th | 0.15th | 0.5th | 0.85th | 0.97th |
| 0.48 | 0.55 | 0.64 | 0.73 | 0.80 |



Sag.ver.Ant.Lobe.CSA..mm.2.

**Brainstem and vermis lobes perimeter and CSA + relation**

# Measurements of the Posterior Fossa

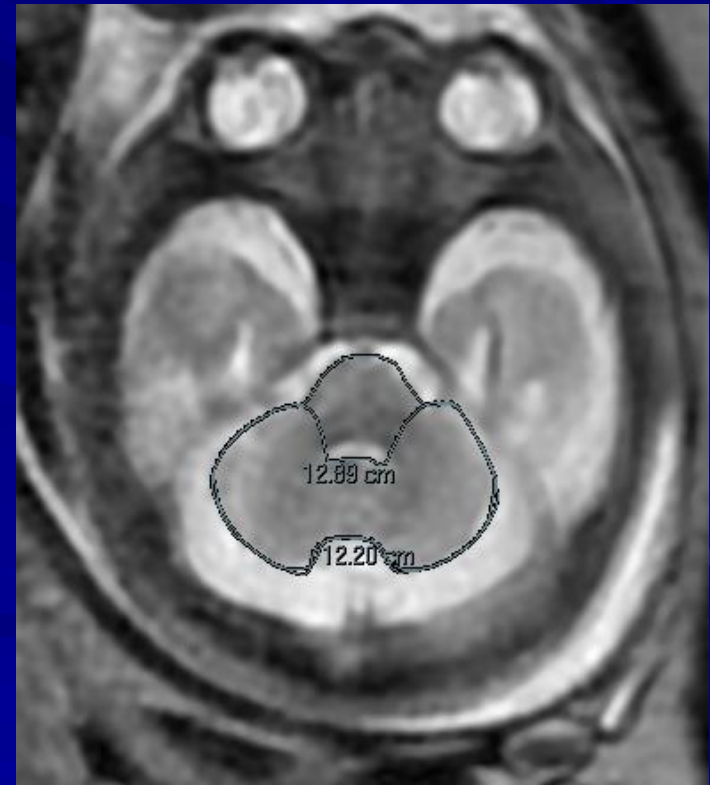## Measurements of new reference data



**Pons S-I and CSA, CM CSA**

# Measurements of the Posterior Fossa

## Measurements of new reference data

**Cerebellum with/without pons perimeter and CSA + relation**

| Cerebellar hemispheres relation | | | | |
|---|---|---|---|---|
| 0.03th | 0.15th | 0.5th | 0.85th | 0.97th |
| 0.88 | 0.94 | 1.00 | 1.06 | 1.11 |



Ax.cer.CSA.w_pons..cm.2.

# Initial Results

## For practical use:

| Brainstem Biometry GW 28 | | | | | |
|---|---|---|---|---|---|
| | **0.03th** | **0.15th** | **0.5th** | **0.85th** | **0.97th** |
| **CM CSA** | 340.24 | 370.50 | 407.66 | 444.81 | 475.07 |
| **BS CSA** | 258.35 | 277.36 | 300.71 | 324.05 | 343.06 |
| **BS Per** | 85.34 | 90.44 | 96.69 | 102.95 | 108.05 |
| **Pons A-P** | 9.22 | 9.69 | 10.27 | 10.85 | 11.32 |
| **Pons S-I** | 10.29 | 10.93 | 11.70 | 12.47 | 13.11 |
| **Pons CSA** | 90.78 | 99.29 | 109.73 | 120.18 | 128.69 |

# A possible case study

**Pathologic**

**Normal**

# A possible case study
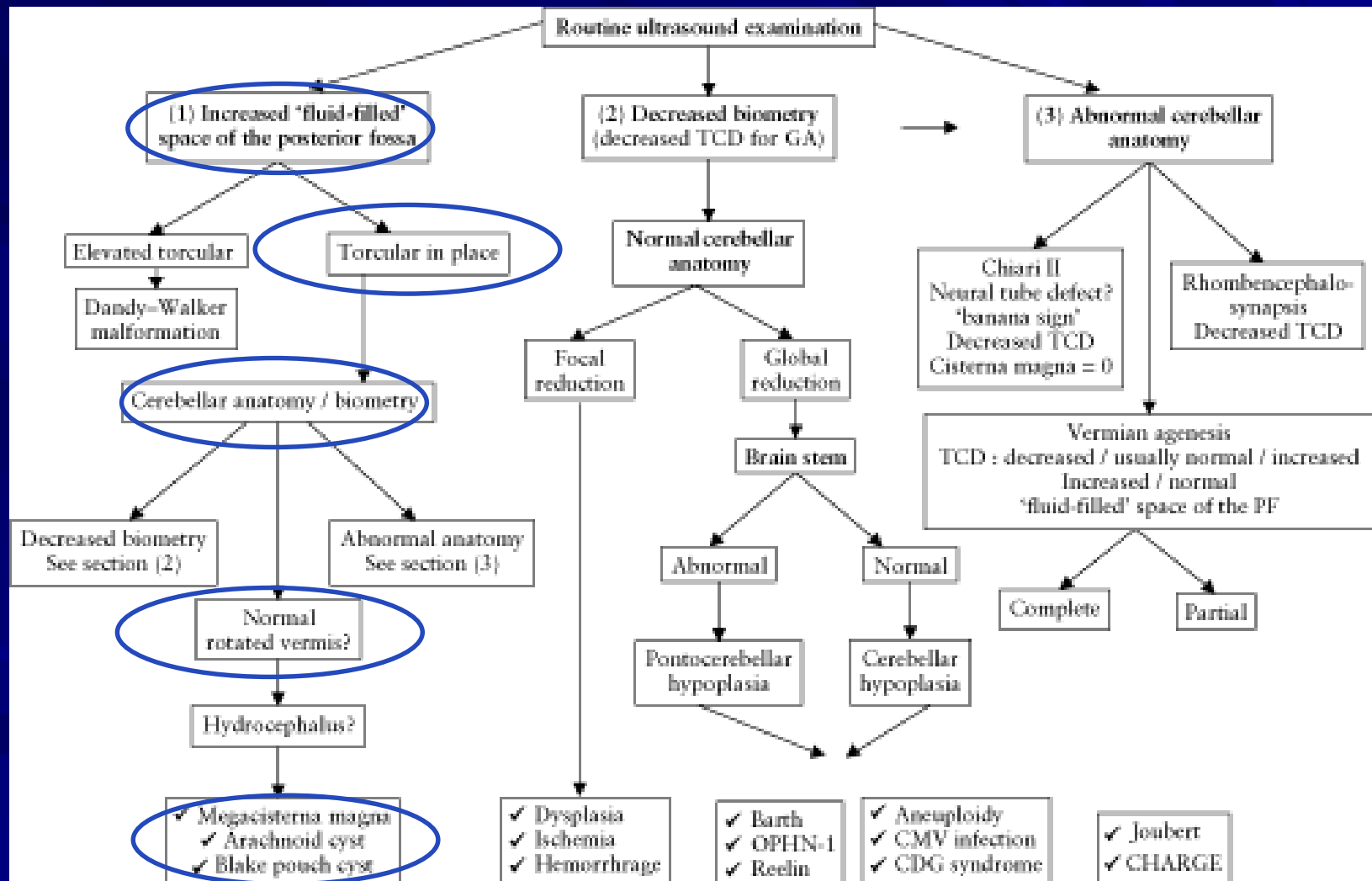
**Pathologic**

**Normal**

# A possible case study

- **Measurments (based on 32$^{nd}$ GW biometry):**
  - Vermis – all measures above 10$^{th}$ percentile
  - Ant/post lobes – normal
  - Brain stem – all measures around 50$^{th}$ percentile
  - CM CSA – above 97$^{th}$ percentile
- **Normal/ Pathological?**
- **What is the pathology?**
- **Prognosis?**

# Possible clinical applications

# Bottom line

**We will have another objective tool to make the correct diagnosis**

# Questions?

**Coronal**

**Sagittal**



# Thank you