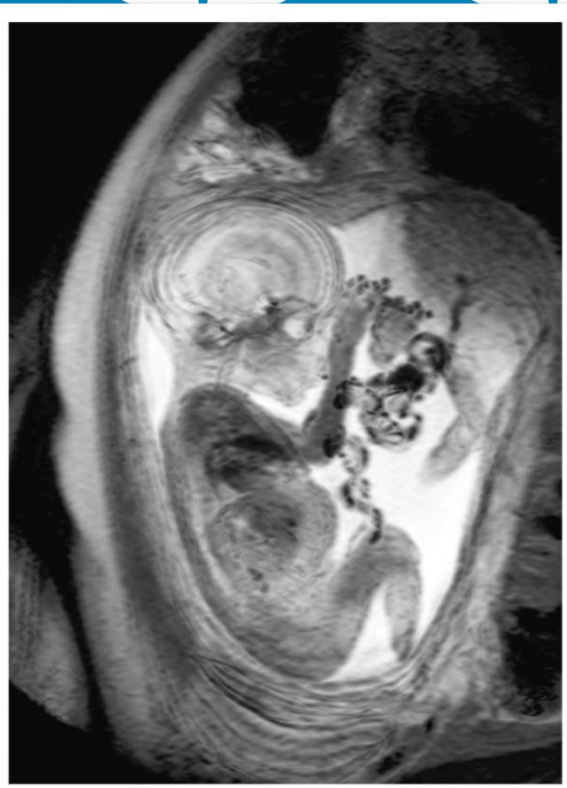
The Chaim Sheba Medical Center at Tel HaShomer



VOLUMETRIC MRI BRAIN ASSESSMENT OF MACROCEPHALIC FETUSES

Mentor:
Dr. Eldad Katorza, Gynecology

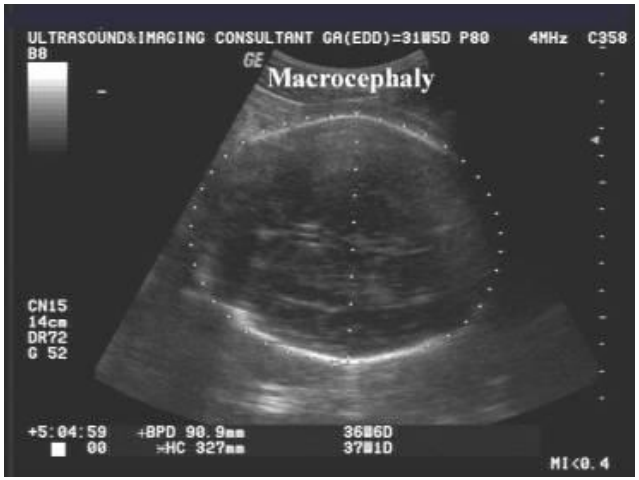
Student:
Shalev Fried

HEAD CIRCUMFERENCE

- The measurement of head circumference (HC) is an important factor in the evaluation of prenatal and postnatal development.
- Deviations from normal head growth may be the first indication of an underlying congenital, genetic, or acquired problem.
- The earlier the conditions associated with increased HC are detected, the earlier appropriate treatment, services, and genetic counseling can be provided.

DEFINITIONS

- **Macrocephaly** is defined as an HC greater than two standard deviations above the mean for a given age or gestation.
- **Megalencephaly** is the enlargement of the brain parenchyma.
- **OMIM** search of macrocephaly returned **395** entries (Nov, 2018).



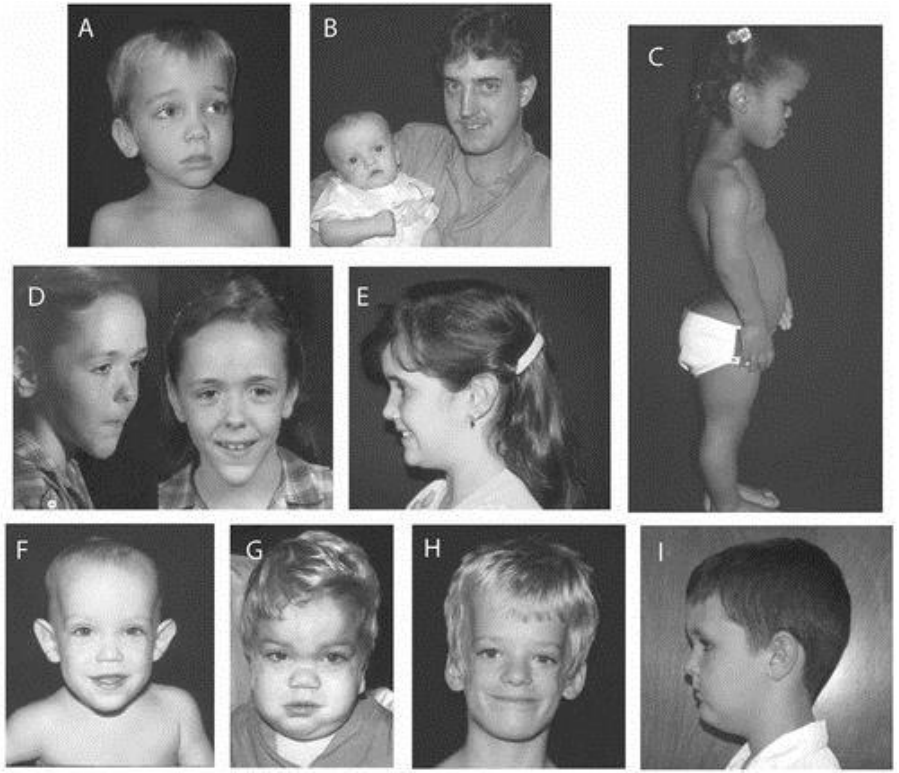
ETIOLOGY

TABLE I. Classification of Macrocephaly Conditions

I. Genetic types
- Familial macrocephaly
  - Benign; symptomatic
- Autism disorder
  - Multifactorial, non-syndromic type
- Syndrome associations (many types)
  - With cutaneous findings
    - PTEN hamartoma syndromes
    - Neurofibromatosis, type 1
    - Hemimegalencephaly
  - With overgrowth
    - Sotos, Weaver
    - Macrocephaly cutis marmorata telangiectatica congenita
    - Simpson–Golabi–Behmel, Beckwith–Wiedemann syndrome
  - Neuro-cardio-facial-cutaneous syndromes
    - Noonan, Costello
    - Cardiofaciocutaneous (CFC)
    - LEOPARD
  - With mental retardation
    - Fragile X
- Metabolic types
  - With leukodystrophy
    - Alexander; Canavan
    - Megalencephalic leukodystrophy
  - With organic acidurias
    - Glutaric aciduria, type 1
    - D-2-hydroxyglutaric aciduria
  - With storage
- Bone dysplasia/hyperplasia
- Hydrocephalus
  - Aqueductal stenosis types
  - Multifactorial, non-obstructive types

II. Non-genetic types
- Hydrocephalus
  - Hemorrhage
  - Infections; other causes
- Subdural effusions
  - Post-traumatic and infectious
- Arachnoid cysts

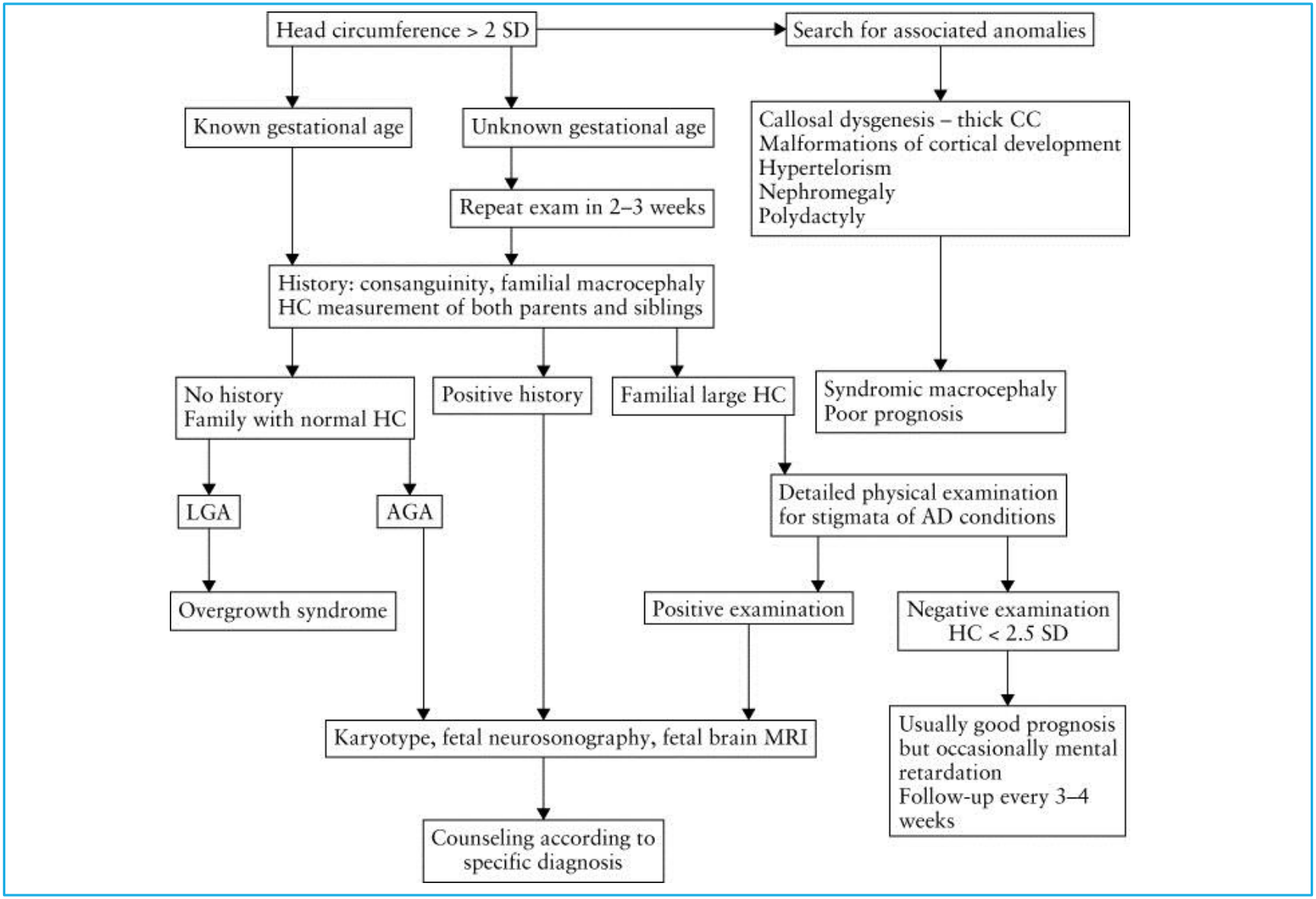
- **Anatomic megalencephaly**
- **Metabolic megalencephaly**



Williams CA, 2008, AJMG

US. PRENATAL DIAGNOSIS

- HC >2 SD? 3SD?
- **limitations in accuracy** of US HC measurements and inconsistency between prenatal and postnatal growth curves.
- Associated US anomalies may indicate syndromic macrocephaly.
- evidence in US usually only at 3rd trimester.
- **Most patients are non syndromic and have normal development.**

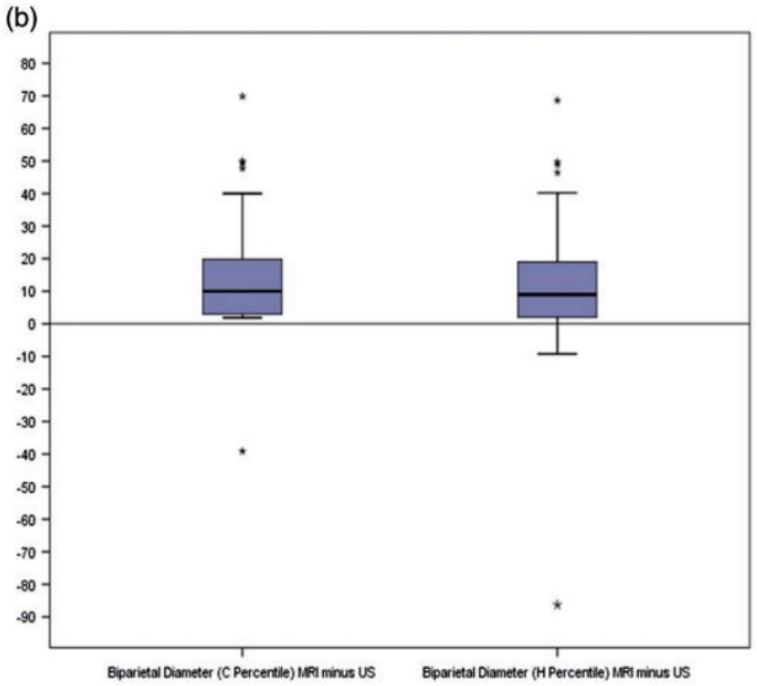


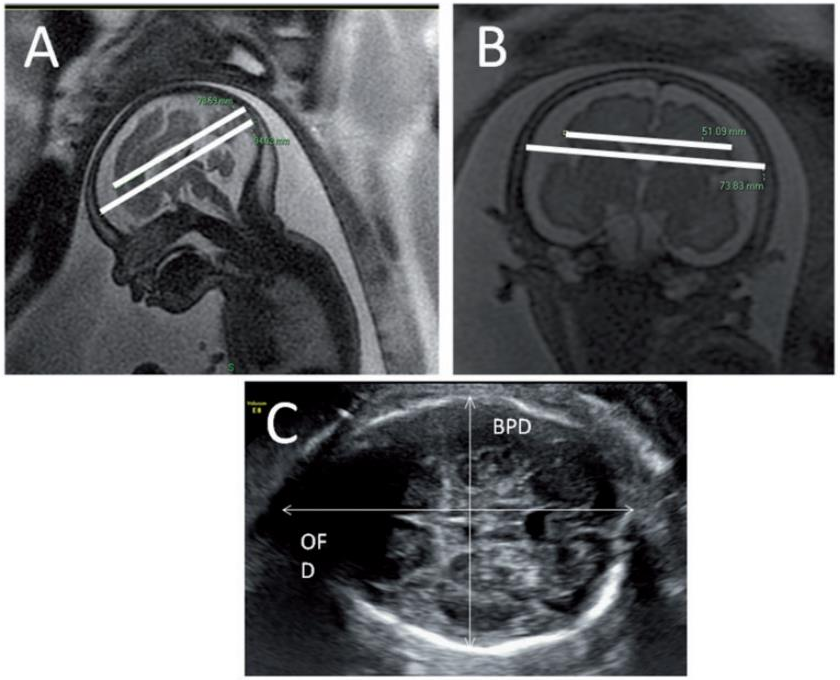
Malinger , 2011

Discrepancy in fetal head biometry between ultrasound and MRI in suspected microcephalic fetuses

Gal Yaniv[1,*], Eldad Katorza[2,*], Vered Tsehmaister Abitbol[1], Arik Eisenkraft[3,4,5], Ronen Bercovitz[1], Salim Bader[1] and Chen Hoffmann[1]

"There was no correlation between US-measured skull biometry and MRI-measured brain biometry."





AJNR Am J Neuroradiol. 2017 Nov;38(11):2193-2198. doi: 10.3174/ajnr.A5349. Epub 2017 Aug 24.

Volume of Structures in the Fetal Brain Measured with a New Semiautomated Method.

Ber R[1], Hoffman D[2], Hoffman C[3,4], Polat A[2], Derazne E[4], Mayer A[3], Katorza E[2].

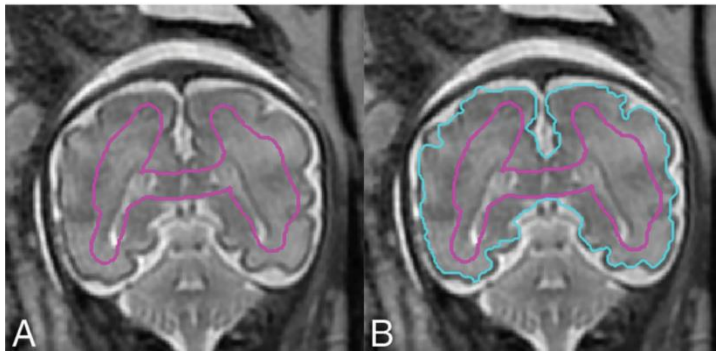
Supratentorial brain

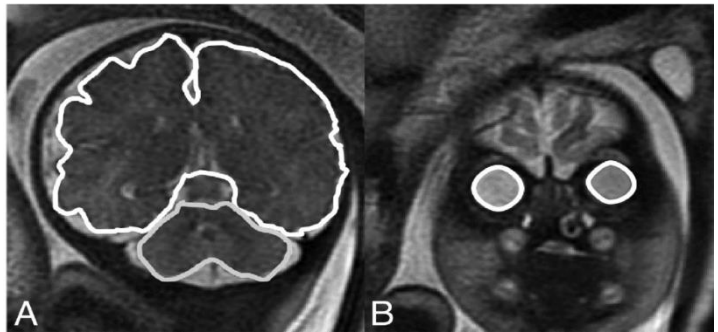
Left and right Lateral ventricles

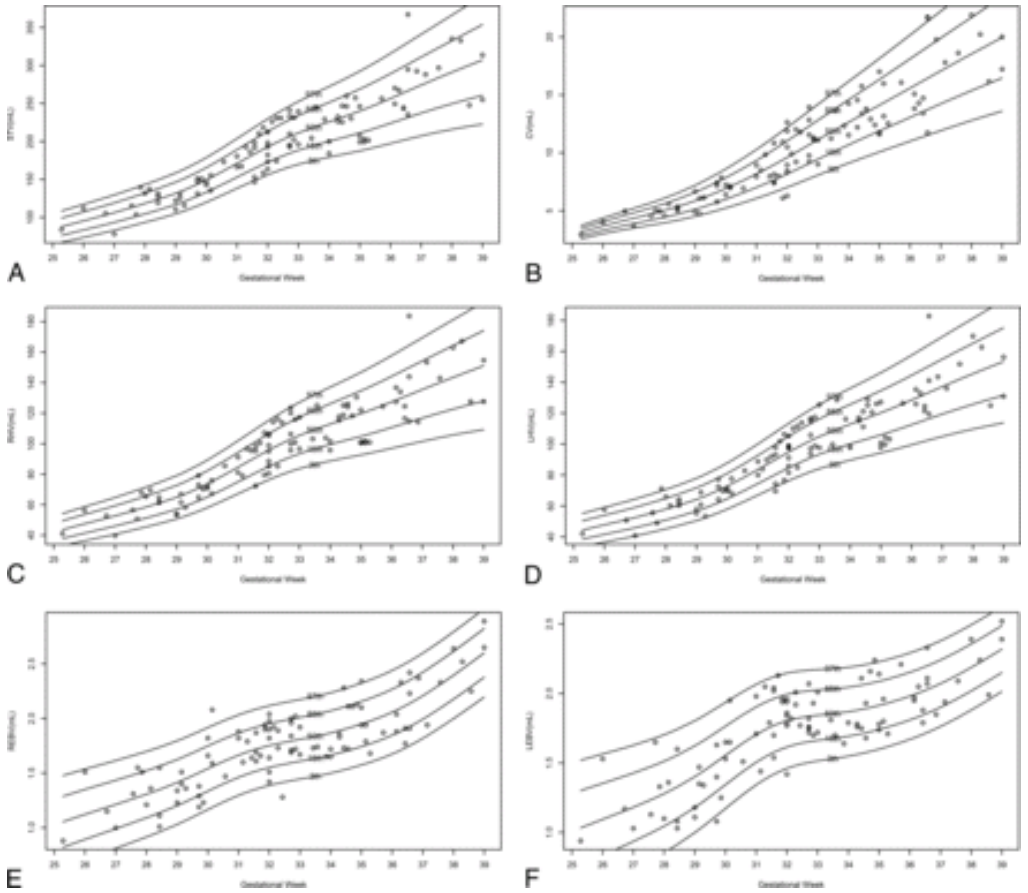
Left and right hemispheres

Left and right eyeball

Cerebellum







RESEARCH QUESTION

- Can fetal macrocephaly be diagnosed more accurately using volumetric MRI measurement?
  - Sensitivity, specificity, PPV, NPV.
- Is there difference in proportional brain structures' volume comparing to normal fetuses?
- Will the volumetric method better differentiate between the different etiologies.
- What maternal parameters attribute to fetal macrocephalia?
- Is there a neurodevelopmental significance to these findings?

INCLUSION & EXCLUSION CRITERIA

- **Inclusion** criteria:
  - HC>1 SD
  - Neurosonogram in Sheba
  - Good quality brain MRI
  - Labor in Sheba
  - Full history and labor data in Chameleon

- **Exclusion** criteria:
  - Multifetal pregnancy
  - Not enough data
  - Absence of full US examination.

MATERIALS AND METHODS

- Data collection of 38 US suspected Macrocephalic fetuses, and 50 controls:
  - Maternal characteristics: age, diseases, medications, previous pregnancies, IVF.
  - Mode of delivery and antenatal and postnatal complications
  - US biometrics of the fetus.
  - Fetal Echocardiogram, Nuchal translucency, Karyotype and CMA
  - Birth weight, length, and other biometrics.
  - Apgar score
  - Developmental disorders
- Assessment of brain volumes using a semiautomated software.
- Neurodevelopmental assessment: preforming Vineland questionnaires

NEURODEVELOPMENTAL ASSESSMENT

VINELAND questionnaires.

- standardized measure of **adaptive behavior**- function in everyday lives.
- Adaptive behavioral skills:
  - Communication
  - Daily Living Skills
  - Socialization
- based on parental report of behavior
- Validated and compared to patients' age group.

THANK YOU!

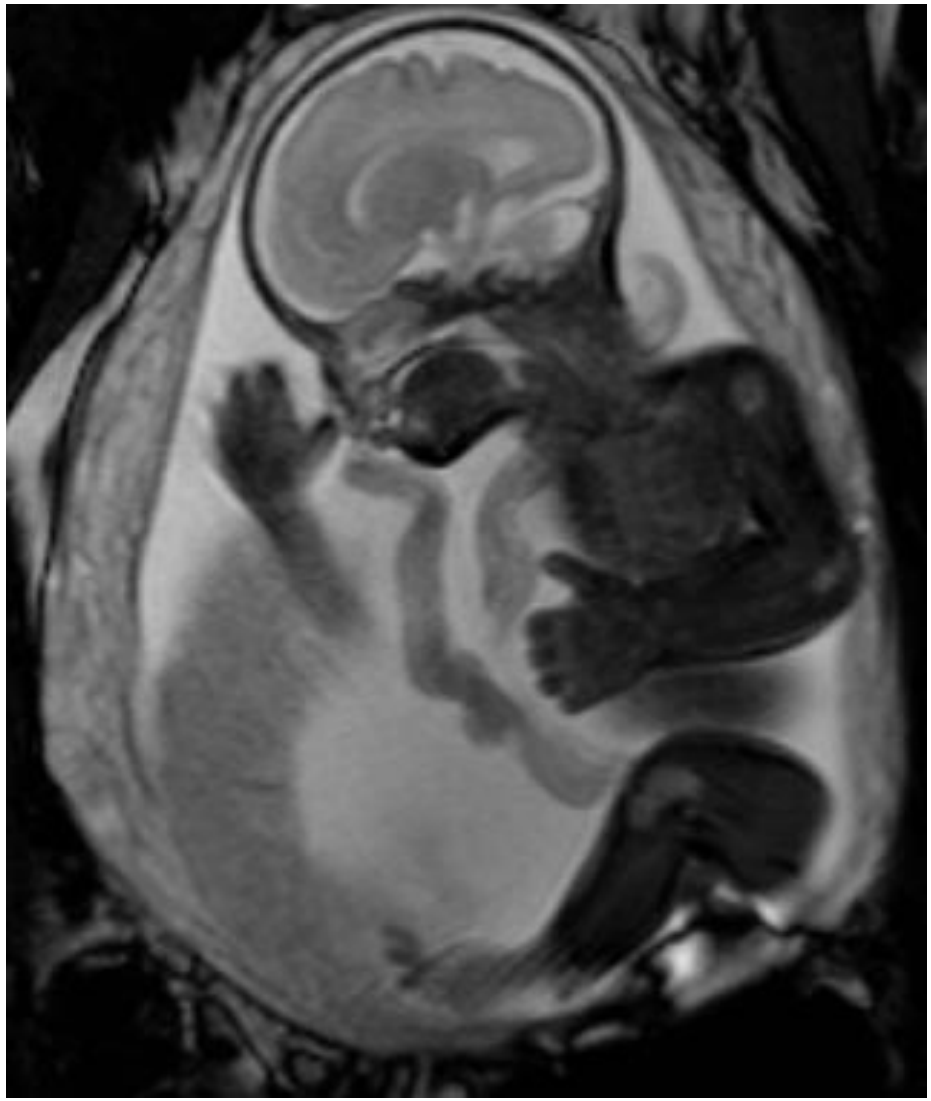
Dr. Eldad Katorza

Michal Gurevitch

Prof. Anat Achiron

Mrs. Yafit Rot

Tomer Ziv- Baran



REFRENCES

Malinger, G. (2011), Can syndromic macrocephaly be diagnosed in utero?. Ultrasound Obstet Gynecol, 37: 72-81.

Williams*, CA. (2008),* Genetic disorders associated with macrocephaly*. Am J Med Genet.*

Ber, R. (2017), Volume of Structures in the Fetal Brain Measured with a New Semiautomated Method. *American Journal of Neuroradiology.*

Gal, y. (2017), Discrepancy in fetal head biometry between ultrasound and MRI in suspected microcephalic fetuses. *Acta Radiologica.*

Biran-Gol, Y. (2010), Developmental outcome of fetal macrocephaly and associated syndromes *Harefuah.*