Volumetric fetal brain pilot study in twins with severe discordancy using semiautomatic 3D MR imaging measurements.

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Fetal brain MRI

- PubMed search of 'fetal MRI' yields 6,792 references (Oct 2018), of which 2,863 include 'fetal brain MRI'.
- Indications for fetal brain MRI:
 - History of severe brain abnormality in previous pregnancy but normal US scan.
 - An isolated abnormality found on US scan.
 - Abnormality on US, but scan can't be complete due to technical difficulties.
 - High risk of development of brain abnormality, especially in cases of fetal infection.
- Timing:
 - Beginning of third trimester (30-32 weeks) is preferred.

3D volumetric assessment of the fetal brain

Eur Radiol. 2017 May;27(5):2110-2118. doi: 10.1007/s00330-016-4502-4. Epub 2016 Aug 4.

Volumetric MRI study of the intrauterine growth restriction fetal brain.

Polat A^1 , Barlow S^2 , Ber R^2 , Achiron R^2 , Katorza E^2 .

- Sample size of 34 fetuses of which 13 IUGR's and 21 controls.
- Manual measurement technique.
- Evaluation of regional brain volumes differences in IUGR.
- Cerebellar to supratentorial brain volume ratios were smaller in IUGR fetuses.
- What is the long term effect?

3D volumetric assessment of the fetal brain

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.

<u>Ber R¹, Hoffman D², Hoffman C^{3,4}, Polat A², Derazne E⁴, Mayer A³, Katorza E².</u>

- Sample size of 94 healthy fetuses.
- Present a new method for MRI brain measurement which is time efficient.
- Good to excellent interobserver agreement.
- Semiautomated results are not inferior to manual technic and are less time consuming and user dependent.
- MRI semiautomated brain volume growth curves.

3D volumetric assessment of the fetal brain

Volumetric Brain MRI Study in Fetuses with Congenital Heart Disease

H. Olshaker, R. Ber, D. Hoffman, E. Derazne, R. Achiron and E. Katorza American Journal of Neuroradiology April 2018, DOI: https://doi.org/10.3174/ajnr.A5628

- Sample size of 46 fetuses.
- Semi automated measurements of fetal brain MRI.
- Good to very good interobserver agreement.
- Cerebellar volume and cerebellum to supratentorial brain volume ratio are smaller in fetuses with CHD.

Semiautomated measurement

- Retrospective coronal section measurements of the following volumes was obtained:
 - Supratentorial brain
 - Left and right hemispheres
 - Cerebellum
 - Left and right eyeballs



Twins BABC MCBA



Discordancy/sIUGR

- **Discordance** when abnormality is detected in a twin gestation the co-twin is usually normal.
 - In growth, this is defined by difference in weight grater than 20% of actual or estimated weight.
- sIUGR estimated fetal weight < 10th percentile of one twin with adequate for gestational age co-twin.
- 10 15% of MCBA twins but also present in BCBA pregnancies.

Research questions

Is there a difference:

- In brain volumes between the twins with severe discordancy/sIUGR that are measured by MRI?
- In brain volumes comparing to the whole body weight discordancy?
- In the neurodevelopmental outcome which correlate to above?
- In the discordancy patterns between BCBA to MCBA twins?

Materials and methods

- Data collection of 18 pairs of MCBA and 15 pairs of BCBA.
 - MRI scans
 - Antenatal complications
 - Mode of delivery
 - Birth weight
 - Dolberg percentile
 - Appgar score

Assessment of brain volumes

Analysis by Matlab-based semiautomated software.

Performing Vineland's questioners

neurodevelopmental assessment.

Results

Fetal brain volume of 14 BCBA and 14 MCBA twins analyzed by MRI semiautomated measurements.











LHV









REBV



LEBV





CV



STV compared to normal growth curve





Neurodevelopment

- Follow up will be done using VINELAND questioners.
- The Vineland-3 is a standardized measure of adaptive behavior.
- Focuses on what the examinee's actually does in daily life.
- Adaptive functioning is compared to that of others his or her age.
- ABC score is based on scores for three specific adaptive behavior domains:
 - Communication
 - Daily Living Skills
 - Socialization

Conclusions

- There is a significant difference in brain volumes between AGA to SGA twins.
- Preliminary results shows brain sparing effect:
 - With lower discordance in brain volume compared to body weight.
 - Results are more robust in the BCBA twin population.

Further evaluation

- Evaluation of brain structures volumes to corrected normal growth curve.
- Evaluation of brain volume to body weight ratio is needed.
- Neurodevelopmental assessment using the Vineland questioners.
- Statistical analysis.

References

- Salomon, L.J. & Garel, C., 2007. Magnetic resonance imaging examination of the fetal brain. *Ultrasound in Obstetrics and Gynecology*, 30(7), pp.1019–1032.
- Gabbe, S., 2016. *Obstetrics : normal and problem pregnancies* 7th ed., Elsevier.
- Ber, R. et al., 2017. Volume of Structures in the Fetal Brain Measured with a New Semiautomated Method. *American Journal of Neuroradiology*, 38(11), pp.2193– 2198.
- Polat, A. et al., 2017. Volumetric MRI study of the intrauterine growth restriction fetal brain. *European radiology*, 27(5), pp.2110–2118.

Questions?

