

ISUOG 2020 Abstract: maximum of 2000 characters

Title:

Longitudinal Shape and Volume Analysis of the Fetal Brain in the context of Fetal Spina
Bifida Surgery

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Objectives:

Fetal myelomeningocele (MMC) repair is a treatment option in fetuses meeting certain criteria to improve long-term outcome. We studied Magnetic Resonance Imaging (MRI) quantification of volume, surface area, and shape of cerebral structures to determine the effect of fetal surgery on brain development.

Methods:

We compared MRI images of 29 MMC fetuses before fetal surgery (<26 weeks), one week and six weeks post-surgery, to 36 age-matched normal controls (21-36+6 weeks).

Automated super-resolution reconstruction provided optimal 3D isotropic brain volumes.

White matter, cerebellum and ventricles were automatically segmented and manually refined; cerebral volume, surface area, and volume/surface area ratio were quantified.

Shape parameter, an indication of brain complexity, was defined as volume/surface area.

Results:

Cerebellar volume growth (mm^3/week) increased in both groups when imaged <26 weeks.

The change was less in MMC fetuses scanned before and one week after surgery compared to controls (median: 419, IQR:188-588 vs 748, IQR:565-838, $p < 0.001$).

Six weeks after fetal surgery, MMC cerebellar volume growth was not significantly different to control fetuses.

MMC ventricular volume growth (mm^3/week) and shape parameter (mm/week) was higher in

the six weeks after surgery compared to control fetuses; (median:3400;IQR:1666-3604,vs 708;IQR: 435-966, $p<0.001$), and (median:0.075;IQR:0.047-0.112 vs 0.022;IQR: 0.009-0.042, $p<0.001$). In that time period, MMC white matter volume growth (mm^3/week) increased, whilst shape parameter change per week decreased compared to controls (median:11446; IQR:10342-11891, vs 10304;IQR: 8254-11192, $p=0.048$), and (median:0.074;IQR:0.058-0.096 vs 0.1;IQR:0.085-0.140, $p= 0.01$).

Conclusion:

Following fetal MMC repair, fetal brain development differs from that of age-matched normal fetuses. These findings may have neurocognitive implications for postnatal outcomes which require further evaluation.