Brain growth in extremely preterm children repeatedly scanned with MRI at term age and late childhood

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Conclusion

Brain growth is impaired in extremely preterm (EPT) children during childhood. We found significantly slower brain volume growth for both grey and white matter in extremely in EPT children compared with full-term controls.

Introduction

Few studies have investigated the development of the brain volume of preterm children and we lack studies only focused on extremely preterm EPT children. Previous studies show that brain volume deficiencies does not compensate over time. The aim is to investigate the growth pattern in only EPT children. (1,2)

Methodology

The cohort consisted of live-born children born before week 27 in Stockholm area between 2004-2007. We included 48 high quality MRI scans at term age and 58 scans at age 9-11. Out of these 28 subjects had high quality scans at both time point. A control group of 15 healthy children born full term scanned at term age and a group of 38 full term born children scanned at late childhood were included. Volume calculations were done for white and grey matter after brain extraction and automatic segmentation. Children with periventricular leukomalacia (PVL), moderate-severe white matter abnormalities, intraventricular hemorrhage grade 3-4 and focal brain lesions were excluded. We subtracted the absolute tissue volume at late childhood with the mean absolute tissue volume at term to calculate the absolute tissue growth from term age to late childhood. For the 28 children with longitudinal data we subtracted the volume at late childhood with the volume at term age for each individual child. We considered growth of cerebral parenchyma (CPAR) as covariate. Sex and age at scan did not have any affect on results. A general linear model was used for statistical analysis in SPSS, $p<0,05$ was considered significant.

Sample carachteristics	Preterm group	Term group
whole sample	N=58	N=38
gender, male (%)	N=27 (47)	N=19 (50)
age at scan (SD)	10.28 (0.81)	10.09 (0,79)
Gestational age	25,56 (0,95)	39,93 (1,06)

Carachteristics of preterm infants

Cohort N	N=58
SGA (below -2 SD)	5/49
Sepsis	39/55
PDA operation treatment	17/55
PDA ibuprofen treatment	35/55
Singleton	48/58
No white matter abnormalities, score 5-6	28/51
Mild white matter abnormalities, score 7-9	23/51
IVH grad 1-2	18/53

Image 1: Segmented MRI images, grey matter, white matter and csf.

Results

EPT children have a significantly slower brain growth from term age to late childhood. After adjusting for growth CPAR there was still a significant growth difference for white matter volume and grey matter volume between the EPT children and the control group.

Brain volumes (cm³)	Preterm group	Term group	Statistic (P-value) Unadjusted	Statistic (P-value) Adjusted*
Whole sample	N=58	N=38		
Grey matter growth (SD)	571.95 (59.73)	595.18 (63.89)	t= -1.787 (0.003)	F=7,947 (0.006)
White matter growth (SD)	297.71 (39,19)	322.67 (41,05)	t= -3.056 (0.078)	F=7.970 (0.006)
Longitudinal sample	N=28	N=38		
Grey matter growth (SD)	566,19 (47,80)	595,18 (63,89)	t= -2,018 (0,039)	F=6,223 (0,015)
White matter growth (SD)	293,06 (32,61)	322,67 (41,05)	t= -3,279 (0,002)	F=6,886 (0,011)

Figure 1: GM= Grey matter. WM= White matter. White and grey matter growth for EPT children scanned repeatedly with MRI (N=28) and full term controls (N=38). * = Significantly less growth of grey matter. **= Significantly less growth of white matter.

References: 1. Monson et al. 2016 JAMA pediatrics. 2. Keunen et al Journal of Maternal-Fetal Neonatal medicine 2012

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