Tracing the Normal Myelination Pattern on Neonatal MRI Brain Imaging; from Birth to Two Years

Dr Sinéad Culleton, Dr Clare Roche, Dr Declan Sheppard
Department of Radiology, Galway University Hospital, Ireland

Purpose

After birth the immature paediatric brain undergoes further maturation and most importantly maturation of the myelinated structures essential for propagation of impulses which will allow normal development. This occurs in a step-wise predictable fashion. Understanding the normal progression of myelination can avoid misinterpretation of normal changes as pathology and also identify pathology affecting the normal maturation process. Disruption in the predicted normal myelination pattern is important to recognise as many referrals in this age range are for investigation of developmental delay or developmental abnormality. This poster presents a systematic approach to recognising the expected myelinated structures at a number of ages from birth to two years.

Discussion

Myelination begins in utero. Maturation is predominantly complete by 2 years of age but does continue into adulthood. The expected progression is cranio-caudally from deep to superficial, from posterior to anterior, with sensory proceeding motor. The major changes occurring in chemical composition account for the changes seen on T1 and T2 imaging. The higher water content mean that the T1 and T2 relaxation times are longer than those of an adult brain. These relaxation times shorten with maturation. From birth to approximately 4 months the normal myelination pattern is the reverse of the adult and white matter is of lower signal than grey matter on T1 (Figure 1) and of higher signal on T2 (Figure 2).

Figure 1: T1-weighted axial image from an MRI brain of an 11 day old neonate. The grey matter is of lower signal on T1 than the surrounding grey matter.

Figure 2: T2-weighted axial image from an MRI brain of an 11 day old neonate. The white matter here is seen as hyperintense to the surrounding grey matter.

T1 and T2 myelination milestones

- **term birth**: brainstem, cerebellum, posterior limb of the internal capsule, optic tract, perirolandic region
- **2-3 months**: anterior limb of the internal capsule
- **3-4 months**: splenium of the corpus callosum
- **4-6 months**: genu of the corpus callosum

T1 is the most sensitive for children < 1 year
T2 is the most sensitive for children > 1 year

T1-weighted axial images of an 11 day old neonate showing myelination in the peri-rolandic region, the posterior limb of the internal capsule and brainstem.

T2-weighted images at 6 months showing myelination of the splenium of the corpus callosum. Image 2 at 10 months and image 3 at 2 years show progressive myelination in the internal capsule, corpus callosum, forceps minor and forceps major.

It is important to understand the normal progression of myelination to identify myelination abnormalities. At two years of age the myelination pattern resembles that of an adult. However, myelination continues in some areas such as subcortical white matter.

References