Examining speech of very-low-birthweight children during everyday activities

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It has been more than 40 years since the introduction of neonatal intensive care which resulted in improved outcomes for very-low-birthweight (VLBW) children (birthweight <1500g and/or gestational age <32wks). Longitudinal studies following infants into adulthood document that although 90% of VLBW infants do not have overt neurosensory disorders, they continue to be in greater risk of lower intelligence, poorer academic performance, and social isolation.1 As a result of these disorders, VLBW children who were born in the US in the late 1970s were 74% less likely to complete high school by the age of 19 than their normal birthweight siblings.2 However, since the 1970s, medical advances in neonatal intensive care have resulted in a more than 50% reduction in hospital mortality rates of VLBW children and a likely decrease in the incidence and severity of cognitive and learning deficits.

In their study, Van der Spek et al.3 examined early speech and language development in VLBW children. Their findings add to the substantial evidence that VLBW children continue to be at risk of intellectual, motor, and speech disorders. The positive news from this study of recently born children is that although the 2-year-old VLBW children had a greater number of phonological errors than their typically developing peers, there was no increase in unusual phonological error patterns, and the VLBW children’s language development, both comprehension and vocabulary, did not differ from their typically developing peers. If this early trend continues through their preschool years, it may be an indication that VLBW children born in the 21st century have a better educational prognosis than the previous generation. Longitudinal studies have shown that preschool-aged children with isolated expressive phonological disorders appear to be clinically distinct from their peers with co-occurring phonological and language disorders and typically have better educational outcomes.4 Children with isolated phonological disorders are primarily at risk for spelling deficits, while children with co-occurring phonological and language disorders are additionally at risk of developing reading comprehension and decoding deficits.

Accurate determination of specific speech and language deficits in very young children is challenging due their limited speech production, attention, cooperation, and reticence to communicate with unfamiliar examiners. Therefore, valid assessments need to include the interactions of young children in everyday activities with familiar caregivers.5 Conversational speech analysis, as used by Van der Speck et al., allows for the examination of specific speech and language parameters including vocabulary acquisition, word length, and phonological error analysis. One limitation of conversational speech analysis with very young children is that a 20-minute recorded interaction may not be a representative sample of the child’s communication ability. Analyses of longer conversational speech samples have been limited by the portability, durability, and memory capacity of the recorders and the hours required of the examiner to analyse the samples. Recent advances in voice recognition and signal processing technology may address these issues. Small recording devices that can be worn by a child have recently become commercially available and are capable of recording up to 16 hours of child and adult vocalizations.5 These extended-time speech samples can be uploaded from the recording devices to a computer for analysis. To date, automated analysis from these small recording devices is limited to analysing turn-taking and the number of vocalizations. As technology expands to enable further analysis of extended-time speech samples of infants and young children, more accurate examinations of specific risk factors for learning, reading, and speech disorders will be feasible and will facilitate treatment strategies targeted to improve chances for the educational success of VLBW children.

REFERENCES

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Reading performance correlates with white matter properties in preterm and term children

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For the family, and for the clinician, the discharge home of an infant born very preterm (VPT) is a source of great joy. The shortest gestation infants will have experienced a complicated and arduous in-patient course. After discharge there are frequently further illnesses and other setbacks. As time passes the focus of the family will increasingly centre on long-term development as it is among this population that a high level of neurodevelopmental impairment is experienced.1

Magnetic resonance imaging (MRI) of the VPT infant brain in the newborn period and later has been energetically researched in recent years. Much of the research has focussed on two areas: (1) the prediction of subsequent outcome from early MRI studies (e.g. MRI at term-corrected age) and (2) the investigation of the structural basis for neurodevelopmental impairments. MRI has given further insight into the nature of the white matter and grey matter abnormalities seen in these infants. Subtle abnormalities of white matter development, not detected on ultrasound, have been found to be present in a significant proportion of surviving preterm infants. Diffuse excessive high signal intensity (DEHSI) on standard T2 images and focal and multifocal T1 shortening are the more common findings.2 DEHSI relies upon a subjective assessment of the T2 image and is subject to some interobserver variability. However, experienced observers have correlated DEHSI with abnormal neurodevelopmental outcome, Dyet et al.2 observing DEHSI in 80% of 119 infants of less than 30 weeks’ gestation at birth, with a significant depression in the Griffiths Developmental Quotient compared with those without DEHSI (DEHSI 94 [SD 11.6], severe DEHSI 92 [SD 7.5], vs no DEHSI 111 [SD 20]; p=0.027).

Studies in later childhood and adolescence have confirmed the observation of a significant lesion load in these infants on standard imaging but not always a consistent relationship between lesions and outcome. Using voxel-based morphometry, Nosarti et al.3 demonstrated global brain development in VPT children in adolescence. Extensive areas of decreased volume in temporal grey matter, putamina, inferior frontal gyrus, thalamus, and caudate were observed. Frontal cortex, cerebellum, middle temporal, and parahippocampal areas showed increased grey matter volumes. Reduced white matter volumes were also observed in various areas together with increased white matter volumes proximal to the areas of increased grey matter volume. Reductions in grey matter and white matter volumes were predictive of cognitive outcome.

The use of alterations in the diffusion of water in tissue studied by MRI allows the study of aspects of brain microstructure in greater detail than that available with conventional imaging. Diffusion tensor imaging (DTI) allows the measurement of (1) apparent diffusion coefficient (ADC), a measure of the water diffusion; (2) fractional anisotropy, the summary of water diffusivity, higher values representing more restricted or greater directionality of diffusivity; and (3) axial and radial diffusivity. Axial diffusivity is that which is parallel to white matter fibres and radial diffusivity refers to the transverse plane, perpendicular to the fibre direction; higher radial diffusivity is thought to represent reduced myelin and/or oligodendroglial restriction of water diffusion. Abnormal ADC, fractional anisotropy, and radial diffusivity values are thought to represent disruption of premyelinating oligodendroglia.4

Counsell et al.5 demonstrated that of 33 VPT children, fractional anisotropy values in the isthmus and body of the corpus callosum were significantly correlated with Griffiths Developmental Quotients scores. Performance subscores were related to fractional anisotropy values in the corpus callosum and right cingulum. Eye–hand subscores were correlated to fractional anisotropy values in the cingulum bilaterally, the fornix, anterior commissure, corpus callosum, and uncinate fasciculus. Fractional anisotropy values did not correlate to loco-motor, personal/social, or hearing/language scores.

Deutsch et al.6 showed a correlation between low reading performance and low fractional anisotropy values in the temporoparietal areas in a small study of 14 children (not VPT). Andrews et al.7 have examined the relation between corpus callosum and temporoparietal FA values and reading abilities in VPT children at a mean age of 11 years 11 months. Their observation that fractional anisotropy values in the callosum relate to reading skills is a novel one and suggests that microstructural injury of callosal white matter may underlie some of the learning impairments in these children. This additional evidence suggests that fractional anisotropy values may be a helpful means to study the nature of these learning impairments.

References


