To the Editor

Neuroembryology in Paediatric Neurology Training Programmes.

In response to Doug Zochodne's editorial request for commentary on his appeal for more teaching of basic neuroscience in clinical neurology residency programmes in Canada (CJNS 2006;33:1), I would begin by endorsing his position wholeheartedly. In the particular case of Paediatric Neurology, the aspect that is most wanting in current clinical residencies is a strong foundation in neuroembryology. Development is the essence of paediatric neurology, and embryology is the essence of development. An understanding of cerebral malformations and even certain neurodegenerative and vascular conditions in the adult also cannot be achieved without this understanding of morphogenesis. Modern embryology also includes integration with molecular genetic programming.

Part of the problem lies in the reduced emphasis on neuroanatomy and neuropathology, or the mistaken belief that neuroimaging is a modern substitute for data derived from tissue examination. Without depreciating the many contributions that neuroimaging has made in the past two decades in clinical diagnosis, the detection of lesions and major malformations and its easy application to living patients, none of the best imaging techniques presently available is a microscope, and the limits of resolution are limited to a size detected by the naked eye. The highest resolution MRI cannot discern tissue architecture: lamination of the cortex, detection of seemingly isolated heterotopic neurons in white matter and their synaptic connections, displacement of a radiologically "absent" septum pellucidum, absence of an internal elastic membrane in the supraclinoid segment of the internal carotid artery, the presence of balloon cells in focal cortical dysgenesis. Whereas direct tissue examination only occasionally becomes available from living patients (e.g. resections of epileptic foci), postmortem examination of those who do not survive despite the best care yields another level of diagnosis and imparts an understanding revealed neither by neuroimaging nor by genetic markers in blood. The microscopic findings provide neuroanatomical confirmation of many diseases and, in the case of fetal and neonatal brains, are almost the only means of detecting pathogenetic mechanisms of malformations.

But how can pathological conditions be comprehended without understanding precise temporal and spatial patterns of normal development of structures of the nervous system? How many senior residents in paediatric neurology training programmes today can describe the precise development of major neuroanatomical structures: the corticospinal tract, the hippocampus, the cerebellum, the corpus callosum, the ventricular system, to say nothing of the development of "minor" structures, such as the fasciculus solitarius (important only for breathing) or the nucleus ambiguus (important only for swallowing)? All residents can tell you when a child normally should sit without support, but how many can explain why a child cannot sit before 6 months of age? How many can describe the ontogenesis of striated muscle and peripheral nerve?

Perhaps neuroembryology is best taught during rotations on neuropathology. But it should be incorporated some place in all training programmes in adult neurology and neurosurgery in addition to paediatric neurology as required topical material. It should be addressed as well by the Royal College in examining candidates for paediatric neurology accreditation. Neuroembryology is a primordial foundation of developmental neurology and cannot be ignored.

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