Pediatric Neurology 71 (2017) 4–7

Contents lists available at ScienceDirect

Pediatric Neurology

journal homepage: www.elsevier.com/locate/pnu

Perspectives in Pediatric Neurology

Child Neurology Training for Pediatricians

Dara V.F. Albert DO [a,*], **Donald L. Gilbert MD, MS** [b]

[a] *Division of Neurology, Department of Pediatrics, Nationwide Children's Hospital/The Ohio State University, Columbus, Ohio*
[b] *Division of Neurology, Department of Pediatrics, Cincinnati Children's Hospital Medical Center/University of Cincinnati, Cincinnati, Ohio*

Pediatricians partner with child neurologists in managing neurological diseases in children. They are often the gatekeepers of referrals to our specialty. Given the undersupply of child neurologists relative to population needs,[1,2] a national discussion about innovative approaches to improve access and care management would be of benefit. An important goal is to continue to attract qualified applicants into child neurology, but the rate of growth within the field is not increasing quickly enough to meet the demands.[2] Gross deficits of child neurologists in the workforce have been present for more than a decade.[3] Pediatricians certainly support this, with one survey estimating a five weeks or longer wait time for neurology consultations.[4]

An equally critical aspect of improving care and reducing strain on the system is the training of pediatricians in basic neurological management skills to enhance their ability to diagnose children, optimize their neurology referrals, and develop their competence in providing routine neurological care and comanaging more complex patients. A recent survey of practicing child neurologists reveals that a large majority believe there is an increase in the volume of referrals to their practice, with nearly half citing an "increase in the number of inappropriate or questionable referrals."[2] An increase in inappropriate referrals from pediatricians could result from suboptimal neurology education during training.

The state of child neurology education during pediatrics training is worrisome. A recent review of the curricula of Accreditation Council for Graduate Medical Education accredited pediatric residencies demonstrates only 16% explicitly require a neurology rotation.[5] The American Board of Pediatrics (ABP) does not recognize neurology as a core specialty and therefore it is not considered to be a required rotation.[6] The ABP does, however, have an extensive list of neurology content specifications for pediatricians to master for initial and maintenance of certification. Similarly, at the medical school level, a substantial proportion of US medical schools do not require a neurology clerkship,[7] and those that do largely focus on adult neurology. Thus a practicing pediatrician may complete both medical school and residency without working directly with a child neurologist. As a direct result of this limited exposure to child neurology, pediatricians may not be adequately prepared to diagnose straightforward neurological conditions they can manage alone nor to make appropriate referrals or ultimately to comanage patients. Pediatric training may also fall short in teaching the appropriate use of evidence-based guidelines for common neurological conditions like first unprovoked seizure,[8] global developmental delay, microcephaly, migraines, concussions, simple febrile seizures, or Bell's palsy.

A recent survey of pediatric residency graduates regarding their experience with child neurology during training and in practice lends insight into perceptions of their educational experience.[5] We propose some changes to improve training of pediatricians based on our experience and a review of the literature.

Teach the neurological history

As the father of neurology, Jean-Martin Charcot once said "To learn how to treat a disease, one must learn how to recognize it. The diagnosis is the best trump in the scheme of treatment."[9] A common presentation in children whose diagnosis relies heavily on thorough history taking (increasingly augmented by smartphone videos) is the evaluation of paroxysmal episodes or movements. Children notoriously may present with paroxysmal movements and behaviors that can be misclassified by caregivers and physicians as seizures or other potentially serious neurological conditions. Training in the careful sequential neurological

Article History:
Received February 16, 2017; Accepted in final form March 26, 2017
* Communications should be addressed to: Dr. Albert; Division of Neurology; Department of Pediatrics; Nationwide Children's Hospital/The Ohio State University; Columbus, OH 43205.
E-mail address: dara.albert@nationwidechildrens.org

http://dx.doi.org/10.1016/j.pediatrneurol.2017.03.018

history-taking and clinical experience seeing children with a variety of neurological problems may prepare pediatricians to make more accurate diagnoses. For example, sometimes the brain is an innocent bystander and generates abnormal movements or "checks out" because it is downstream from problems in another organ system. Apparent dystonia may really be because of gastrointestinal reflux (Sandifer syndrome). A suspected generalized tonic-clonic seizure may be a fall to the ground with jerking movements because of vasovagal syncope. Apparent complex partial seizures may be an interruptible behavioral arrest with posturing or flapping because of complex motor stereotypies or infantile masturbation syndrome. Child neurology clinics are full of children with symptoms such as these. Child neurologists should strive to teach pediatricians that the key to distinguish these events is a good neurological history, specifically the meticulous teasing apart of the sequential details of the episode itself.[9] Using a skill, Oliver et al.[10] refer to as separating the "signal from the noise"—neurologists have learned the ability to sift through a "noisy" history and get to the important information. If the key details are overlooked by a poorly trained historian, unnecessary testing, inappropriate referrals, or harmful misdiagnosis or treatments could result.

Teach the neurological examination

The neurological examination is a powerful diagnostic tool wielded by trained neurologists and takes much repetition to perfect. The goal of the neurological examination is to test or confirm hypotheses generated during the history about the cause of the patient's symptoms. A unique feature of the neurological examination, when used properly, is its ability to generate data that allow a clinician to localize a problem within the neuroaxis, from cerebrum, cerebellum, brainstem, spinal cord, nerves, neuromuscular junctions, and muscle. For generalists, at least, creating a skill level that allows reasonably accurate differentiation between "central" and "peripheral" versus non-neurological etiology could improve diagnostic testing and referral strategies. As neurologists, we are the ideal teachers of these skills. In the 2002 proposed neurology clerkship guidelines for medical schools, it was recommended that the neurological examination be a central part of the curriculum and that it be taught to medical students by neurologists.[11] However, as previously noted, only half of US medical school graduates have had a neurology clerkship experience by the time they enter pediatric residency,[7] leaving the potential for significant gaps. In 1994, Jozefowicz coined the term *neurophobia* and defined it as a fear of neurology among medical trainees, which, he hypothesized, stems from an inability to apply basic science concepts to bedside clinical neurology.[12] Since then, many authors have postulated one of the etiologies of *neurophobia* is fear regarding the complexity of the neurological examination and the ability to apply the findings to the clinical scenario.[13,14]

Teach pediatricians about child neurology in an outpatient setting

Child Neurology, along with many other medical specialties, has moved to a predominantly outpatient practice.[15,16] Recommendations for medical students to spend time in outpatient neurology clinics have previously been made,[11] and outpatient experiences have been linked to improved scores on measures of clinical knowledge and skill.[17] Pediatric residency graduates report seeing children with neurological disorders at a high frequency, with headaches and seizures being the most common.[5] The overwhelming majority of pediatricians report seeing headaches very frequently and will evaluate and treat these children. Likewise, many pediatricians report encountering seizures in practice and report some degree of confidence in evaluation and management. Not surprisingly, pediatricians in general practice were less likely to encounter the esoteric neurological disorders that are more often seen in the hospital and were less comfortable in evaluating and managing. Many pediatricians believed they would have benefited from increased neurology education during training.[5] Given the high prevalence of headaches and seizures, and the ability to interact with the large proportion of such patients whose symptoms seldom require hospitalization, the outpatient child neurology clinic is ripe for teaching pediatricians basic neurological history-taking and examination skills. It also provides trainees with a longitudinal perspective of neurological disorders.[15]

Teach fundamentals of EEG to pediatricians

Electroencephalography (EEG) is the most commonly ordered diagnostic study in child neurology. In many centers, a large proportion of EEGs are ordered by pediatricians.[18] However, many pediatricians receive no training on the indications, limitations, and interpretation of EEG. There is value in non-neurologists recognizing the indications for ordering an EEG and possessing basic knowledge of how to interpret the report. Misunderstanding may lead to unnecessary tests and referrals to neurology, incorrect diagnoses, increased health care

TABLE 1.
Online Neurology Education Resources Available, Along With Descriptions of the Content

Online Educational Resource	Brief Description
Neuromuscular Disease Center at Washington University in St. Louis http://neuromuscular.wustl.edu/	For learning about diseases of the nerves, neuromuscular junctions, and muscles
Online Mendelian Inheritance in Man OMIM.org	For learning about genetics and genetic disorders. Can function as a search engine
GeneReviews https://www.ncbi.nlm.nih.gov/books/NBK1116/	For learning about genetics and genetic disorders
Genetics Home Reference https://ghr.nlm.nih.gov/	For providing information to families about genetics and genetic disorders
Genetic Testing Registry https://www.ncbi.nlm.nih.gov/gtr/	For learning about available testing for genetic disorders