Principles and Practice of Clinical Electrophysiology of Vision

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Testing Pediatric Patients

Anne B. Fulton

Testing children has a reputation of being technically difficult. Nevertheless, electrophysiological testing is an attractive approach to assessment of the neurophysiological substrate of a child's vision. Because the subject's role in producing the electrophysiological response is passive, the visual system function of preverbal and developmentally delayed patients may be more directly evaluated than by behavioral methods. (When psychophysical testing is also available, the electrophysiological data usually complement rather than duplicate the psychophysical results.)

Electrophysiologists know that the tests can be used to secure specific diagnoses or localize the site of dysfunction along the visual pathway. It is, perhaps, somewhat of an art to communicate this knowledge to the parents. Furthermore, the examiner can anticipate that parents will want to know the particular piece in the diagnostic puzzle that the test results will provide.

Families often arrive in the laboratory anxious about the procedures as well as the child's condition; the electrophysiologist is called on to counter these fears with relevant information about the nature and purpose of the tests. Parent-examiner trust is of prime importance in most cases. Once this is established, nearly all awake infant and young child patients can comply with procedures for successful electrophysiological testing.[3] The parents' confidence is easier to gain if the examiner recognizes the anxiety provoking circumstances that have led to the referral for electrophysiological testing. Among the diagnostic possibilities under consideration may be an incurable or progressive disease or a disorder characterized by lifelong visual impairment.

Before the session begins, the procedure is described while the family is shown the equipment. Few families have been in a laboratory environment; time is needed to introduce them to this special but not necessarily frightening environment. Details that laboratory personnel come to take for granted are shown to the family. For example, "this lamp is a special one because it flashes. This TV is an odd one that makes only black and white squares." They need to know where the child will lie or sit and what will be felt, seen, and heard by the child. The risks of the equipment causing the patient physical injury are very small. Conditions can be controlled so that corneal abrasions from electroretinographic (ERG) electrodes are extremely unlikely. None of the electrophysiological tests need cause any pain beyond perhaps the momentary stinging of the eye drops used before inserting an ERG electrode. Families need to be reassured on this point.

Childhood behaviors would appear designed specifically to thwart electrophysiologists' efforts. It is not natural for kids to hold still. They do not like to be restrained. Their attention spans are shorter than adults'. To circumvent effects of the child's activity on the recordings, successful approaches have been developed. Gentle restraint is used as necessary for safety, but otherwise the child is enticed to be sufficiently quiet and attentive for successful testing. For infants, a bottle may be reserved until test time, or a pacifier may be used. The monotonous rhythm of a music box calms some in a dark ERG test room. Video cartoons superimposed on pattern stimuli enhance the child's cooperation.[4] The test room is kept free of auditory and visual distractions. Patterns for visual evoked potential (VEP) stimuli, typically presented on video monitors, are masked so that other equipment and personnel do not distract the child.

Deft, gentle application of the electrodes and facility in operation of the test equipment are important to keep the procedures as short as possible.

Recording artifacts are a greater problem in infants and children than in adults. Therefore, unless single-flash recordings are clearly successful, signal averaging for retinal as well as brain recordings are strongly recommended. Furthermore, equipment should permit rejection of artifacts.

With this preparation, child testing can proceed successfully by using protocols similar to those used for adults. Certainly protocols that allow a flexible approach are helpful. For ERG testing, only steady-state retinal adaptation conditions are used so that time is not a critical variable. If the examiner triggers the stimuli, data collection can be interrupted until stable records are obtained. Occasionally an uninstructable patient does require anesthesia or sedation, which may alter electrophysiological responses.[1, 2, 5, 6] Therefore, recording from anesthetized or sedated young patients is not recommended as the first line of approach.

Interpretation of young patients' electrophysiological responses depends upon comparison to norms for age. Normative values for frequently used test conditions have been summarized in a recent publication.[3] The largest developmental changes in ERG and VEP responses take place in the first postnatal year, which may complicate or delay the interpretation of tracings in an infant with abnormal vision and recordable ERG, and serial testing will be necessary. The postnatal changes in the ERG and VEP responses are taken as signs of maturing visual system physiology. Although the electro-oculogram (EOG) has been studied less extensively, no age-related changes in Arden ratios have been found.[3]

Many pediatric patients referred for electrophysiological evaluation have complex medical and neurological problems. The electrophysiological results may well impinge on the diagnosis and care provided by neurologists and pediatricians. Many of the children have developmental delays and visual inattention or may be described as "low-vision pediatric patients." Thus, the electrophysiological results are of interest not only to physicians but also the personnel in early intervention programs. Reports should, of course, compare the patient's current results with normal for age and with the patient's own previous results. Any comments, if made, as to implications of the electrophysiological results for visual behavior and future vision are best couched in conservative, commonsense terms. Usually, explanations of electrophysiological test results are left to the referring physician.

REFERENCES

1. Bagolini B, Penne A, Fonda S, Mazzetti A: Pattern reversal visually evoked potentials in general anesthesia. *Graefes Arch Clin Exp Ophthalmol* 1979; 209:231–238.
2. Declerck AC, Oei LT, Arnoldussen W, te Dorsthorst M: Alterations in transient visual-evoked potentials induced by clonazepam and sodium valproate. *Neuropsychobiology* 1985; 14:39–41.
3. Fulton AB, Hartmann EE, Hansen RM: Electrophysiological testing techniques for children. *Doc Ophthalmol* 1989; 71:341–354.
4. Spekreijse H: Comparison of acuity tests and pattern evoked potential criteria: Two mechanisms underly acuity maturation in man. *Behav Brain Res* 1983; 10:107–117.
5. Whitacre MM, Ellis PP: Outpatient sedation for ocular examination. *Surv Ophthalmol* 1984; 28:643–652.
6. Wright KW, Eriksen KJ, Shors TJ, Recording pattern visual evoked potentials under chloral hydrate sedation. *Arch Ophthalmol* 1986; 104:718–721.