Implementation of VEP & PERG Technology: How Electrophysiology Can Enhance Patient Care

Presented By:
Randolph Brooks, OD, FAAO
Advanced Eyecare Associates
Ledgewood, NJ

Disclosures

- Consultant for Diopsys® who is sponsoring this CE today.
- I am solely responsible for course content
- Consultant for Bausch and Lomb®
- Consultant for Vistakon®
- Past AOA President

What do you think of when you think of electrophysiology?

Electrophysiology Of Vision

ERG
Electroretinogram
- Electrical activity of the retina

VEP
Visual Evoked Potential
- Electrical activity of the visual cortex

Electrophysiology Of Vision

ERG
Electroretinogram
- Inner retinal layers
- Pattern-Electroretinogram

fERG
Flash-Electroretinogram
- Outer retinal layers
- Flash-Electroretinogram
Why I Added the Electodiagnostocs to My Practice

Electrophysiology objectively measures strength and speed of the visual signal to the brain (VEP) or retina (PERG)

When Do I Use Electrophysiological Tests?

- Clarify Differential Diagnosis.... Is it Systemic or Trauma vs. Ocular?
- When Standard Tests are Unattainable or Unreliable
- When Other Tests are Inconsistent or Borderline Result
- To Monitor Subclinical Disease for Functional Changes and Alter Treatment and Efficacy

Per NIH and Bascom-Palmer

"In patients who are glaucoma suspects, PERG signal anticipates an equivalent loss of OCT signal by several years (as many as 8 years)."

DOI:10.1167/iovs.12-11026
VEP and Glaucoma: Well Defined Science

The Visual Evoked Potential in Glaucoma and Ocular Hypertension: Effects of Check Size, Field Size, and Stimulation Rate


"Glaucoma has also been reported to affect the VEP by causing both reductions in amplitude and increases in latency."

"Increased pattern VEP latency was significantly correlated with both the severity and location of visual field defects and the degree of cupping and pallor of the optic disc."

"Under this stimulus condition, 16 of the 30 eyes with glaucomatous field defects had abnormally long VEP latencies. None of the VEPs from the normal subjects had abnormally long latencies. It is of particular interest that 9 out of 40 of the eyes of ocular hypertensive patients had abnormally long VEP latencies. These nine eyes were from five patients."
“In spite of these significant correlations, it should be noted that nearly half of the eyes with glaucomatous field defects (14 of 30 eyes) generated normal VEPs even though many of these defects clearly encroached upon the macula. We performed additional tests on 9 of these patients in an attempt to understand why these patients generated normal VEPs.”

“Reducing the intensity of the stimulus display by as much as 1.5 log units—to the range of the targets used to map the visual fields—caused abnormal VEPs (either abnormally long in latency or unrecordable) in five of these nine patients.”

“The finding that is of clinical importance is the presence of abnormally long VEP latencies in some patients with ocular hypertension. The abnormal prolongation of VEP latency in these eyes may reflect subclinical optic nerve lesions that have not been uncovered with other techniques.”

Additional Clinical Papers


VEP – Summary for Use

VEP is an objective, functional test that can help discriminate between healthy and diseased eyes

1. Differentiate ocular from systemic, trauma or other conditions for co-management

2. Diagnosis and management of ophthalmic concerns
   - Alternative to VF or VA (need reliable results for diagnosis and treatment)
     - Visual Field Defects H53.40
     - Subjective Visual Disturbance H53.10
   - Questionable vision or diagnostic inconsistencies
     - Conversion disorder (malingering) F44.4 - F44.7
     - Visual disturbances H53.xx
     - Optic Nerve and Pathway disorders H47.xx
   - Subclinical vision disorders for diagnosis and management
     - Disorders affecting optic nerve H47.xx
     - MS/Optic neuropathy H53./H47
     - Optic neuropathies H47.xx
     - Unexplained vision loss H53.13x
     - Transient visual loss H53.12
     - Visual field defects H53.xx
     - Amblyopia/Strabismus H53.xx
     - Traumatic brain injury S06.xxxxx

Normal VEP Response

Amplitude measured in microvolts indicates amount of electrical energy reaching visual cortex

Latency measured in milliseconds indicates time for electrical signal to reach visual cortex

Waves after N135 are insignificant
Normal VEP Response

- Good waveforms
- Amplitude and Latency in green
- P100 Signal Index above 70%

Abnormal VEP

- Right eye shows delays in latency at both high and low
- Low contrast demonstrates changes to the magnocellular pathway – Earliest functional degradation shown in glaucoma patients

Pattern ERG = PERG

- Main Indications
  - Glaucoma
  - Maculopathies

Clinical Applications of Electrophysiology in Ophthalmology

ISCEV Indications

- Inherited retinal dystrophies
- Vascular diseases including diabetes
- Opaque media or trauma
- Retro bulbar neuritis
- Unexplained visual loss
- Infant with questionable vision
- Toxic and nutritional eye disease
- Glaucoma
- Suspected intracranial lesion

PREVIOUS LIMITATIONS

- Test time was approximately 45 minutes
- Required highly trained operators
- Limited to large research institutions
- Required highly trained neurophysiologists

CURRENT CONDITIONS

- Actual test time is considerably shorter
- Does not require highly trained operators
- Easy to use, intuitive software
- Comfortable for the patient, convenient for doctor and staff
PERG is a useful tool for the early diagnosis of glaucoma

How Does PERG Work?

Pattern electroretinogram (pERG) is an electrical recording of retinal function in the macula and ganglion cells stimulated by contrast-reversing patterns, usually black and white, with constant luminance.

Pattern Electroretinogram (pERG)

- pERGs are electrical signals that are a measure of the electrophysiological activity in the ganglion cells in the retina.
- Can help improve sensitivity and specificity in diagnosing neuropathies and maculopathies like macular degeneration and glaucoma when used in conjunction with other tests.
- Can also help the clinician differentiate between retinal and optic nerve disorders when used in conjunction with Visual Evoked Potential (VEP).

How Does PERG Work?

Since the PERG is a local response from the area covered by the retinal stimulus image, specifically GCC, it can be used as a sensitive indicator of dysfunction within the macular region and it reflects the integrity of the optics, photoreceptors, bipolar cells and retinal ganglion cells.

MagnitudeD

- MagnitudeD takes into account magnitude and phase variability throughout the recording.
- A recording that is in phase throughout the test will produce a MagnitudeD value close to that of Magnitude.
- A recording that is out of phase throughout the recording will produce a MagnitudeD value significantly less than that of Magnitude.
- In a patient with disease, the phase response tends to be inconsistent throughout the test.
**PERG Protocol Selection**

- Chronic Open Angle Glaucoma
- Diabetic Retinopathy
- AMD
- Diabetic Macular Edema
- Toxic Maculopathies

**Lid Sensors: A Comparison**

Purpose:
To evaluate how the Diopsys-NOVA ERG skin electrode, DTL electrode and the Ag/AgCl electrode affect the Pattern ERG response.

Conclusion:
The Diopsys NOVA-ERG skin produced a significant improvement in recording the PERG amplitude parameter as compared to the DTL and Ag/AgCl cup electrodes. There was no loss of PERG latency information when the Diopsys NOVA-ERG electrode was used.

Evaluation of Pattern ERG responses using various electrodes.
ARVO 2016
Anna Shengelia,1 Celso Tello,1,2 John Siegfried,3 Peter Derr4
1Einhorn Clinical Research Center, New York Eye and Ear Infirmary of Mount Sinai, New York, New York, 2Manhattan Eye, Ear and Throat Hospital, Hofstra North Shore-LIJ School of Medicine, Manhasset, New York, 3Salus University, Elkins Park, Pa, 4Diopsys Inc., Pine Brook, NJ

Purpose: To evaluate how the Diopsys NOVA ERG skin electrode, DTL electrode and the Ag/AgCl electrode affect the Pattern ERG response.

Conclusion: The Diopsys NOVA-ERG skin produced a significant improvement in recording the PERG amplitude parameter as compared to the DTL and Ag/AgCl cup electrodes. There was no loss of PERG latency information when the Diopsys NOVA-ERG electrode was used.

**3 Quick Steps To Report Interpretation**

**Normal PERG Response**
- Signal Quality: Look for a green signal
- Sinusoidal Peaks: Look for 3 humps
- Magnitude, MagnitudeD and MagD/Mag ratio are colorized.
- Green indicates within normal limits
- Yellow indicates values are borderline
- Red indicates outside normal limits

**Abnormal PERG**
- Missing 3 humps

Yellow indicates values compared to normal are borderline
Red indicates values are outside normal limits
Purpose: The purpose of this study was to investigate the test-retest repeatability of two novel office-based electrophysiology platforms: flash electroretinogram (fERG) and steady-state pattern electroretinogram (ssPERG) in normal subjects.

Conclusion: Test-retest repeatability of ssPERG and fERG (flicker and white flash) using a novel office-based testing platform ranged between good to excellent for all tested parameters.


Macular Function Evaluation in Eyes With Cataracts

ISCEV* Recommend using ERG for the evaluation of retinal function in patients with media opacities.

* (International Society of Clinical Electrophysiology of Vision)

iscev.org/standards/procedureguide.html
Where Medical Necessity and Coverage Meet

**VEP CPT 95930**
- For subclinical optic nerve concerns (beneath the surface of clinical detection)
  - H47 (optic nerve/pathway disorders)
  - H63 (questionable vision)
- Systemic or Traumatic manifestations that affect vision
  - H63 (visual disturbances) or other signs and symptoms or concerns from
    - Neurological, TBI, Infectious, Infiltrative, Degenerative,

**ERG CPT 92275**
- For subclinical retinal concerns (beneath the surface of clinical detection)
  - H40.00-H40.069 Glaucoma suspects
  - H47 (optic nerve/pathway disorders)
  - H40.10X0-H40.9 Confirmed glaucoma (mild to moderate stage)
  - H30-H36 Retina (DR), Macula (AMD) and toxicity concerns

Can Both Test be performed on the same day?

- Both tests seen used to locate dysfunction – is it retinal (ERG) or retrobulbar (VEP) - optic nerve to visual cortex?
- Always requires documentation of medical necessity and impact on care
- May be performed same day as other tests, NO Correct Coding Initiatives
- Select the most appropriate ICD for the chief reason for the test – different reasons for different tests

Reimbursement

National Average CPT Codes
95930 (VEP) and 92275 (ERG) each exceed $100*

* Insurance codes may vary by contract.

Use clinical judgement in the use of Electrophysiology instrumentation

Questions

How and where do you schedule electrophysiology testing in the practice? With other tests? Or on a different day?

Questions

- How long did it take for your staff to become proficient in testing patients?
Conclusions: Clinical

- Electrophysiology using both VEP and ERG can give important clinical data that practitioners can use in both diagnosis and treatment.
- There is an increasing large body of evidence based research that supports clinically appropriate use.
- This office based technology can be easily utilized by practicing ODs with support from manufacturers.
- Staff support and patient education are important considerations in technology adoption.

Conclusions: Reimbursement

- Reimbursement is available when medically necessary and with appropriate interpretation and report.
- Do not consider electrophysiology in a patient self-pay screening format.
- Utilize the services of instrument manufacturers for support and assistance with reimbursement issues.
- Understand that early adopters of clinically appropriate technology are doubly rewarded—better patient care and higher reimbursement.

Thank you!

- Feel free to email any questions or comments.
- drbrooks@advanced2020.com