Department of
Clinical Engineering

Royal Liverpool
University Hospital

British
Society
for Clinical
Electrophysiology
of Vision

British Society for Clinical Electrophysiology of Vision

Second Annual Meeting

Hosted by the Department of Clinical Engineering

Royal Liverpool University Hospital

at

The Merseyside Maritime Museum

14th & 15th June 2004

Welcome to BriSCEV 2004

It is with great pleasure that I welcome you all to the official opening of BriSCEV 2004 on the historic waterfront in Liverpool.

This is only the second meeting of this new society which has been formed for two important reasons:

- Firstly, British clinicians and scientists make a significant contribution to the worldwide effort to develop knowledge and understanding of electrical responses of the visual system. They also contribute to the development of clinical uses of the responses. It is therefore appropriate to have a British society to promote this work and to communicate with a wider range of interested parties than would attend international meetings on the subject.
- Secondly, the results of clinical electro-physiological tests, measurements and procedures affect the management of patients with disorders of vision. It is now seen nationally as necessary to have a professional body to regulate the training, testing standards, and reporting quality, as in other areas of healthcare science.

Over the next day and half we shall all have our heads filled with so much information, some from world class experts in their fields, and some from relative newcomers making their first entry into this field. I invite you all to make the best possible use of this excellent opportunity to learn some new ideas, or to sharpen up your knowledge in areas where you might be rusty.

ISCEV, our international society has always managed to counter the serious stuff of the academic sessions with a great deal of fun in the social programme. Indeed some of my best friends (by that I mean the people I most like to gossip about) were first encountered at ISCEV meetings, and we continue to develop these friendships each year. We hope at BriSCEV to do the same. So, take this opportunity to make new friends, and then follow up next year, and the next.

By modern standards Liverpool is quite a small city, but it has a huge personality- (average VEP amplitude 85uV). Liverpudlians cannot speak or sit quietly, and when greeting each other, a witty remark is obligatory. Unfortunately most of you here today will miss out on this excellent custom because of a language barrier.

The BriSCEV2004 programme has no epilogue, so I will include a thank-you here to all those who have worked to make the meeting happen, to the presenters, and the delegates (and their generous employers).

Malcolm Brown
Local Organising Committee

UK

Amjad, Syed	Bangor Hospital, North Wales
Arlotte, Dominique	Cardiff University
Baldwin, Deborah	Royal Victoria Infirmary, Newcastle upon Tyne
Barber, Colin	Queens Medical Centre, Nottingham
Bates, Gemma	Leicester Royal Infirmary
Bishop, Andy	Oxford Instruments Medical Ltd
Bradnam, Michael	Yorkhill NHS Trust, Glasgow
Bradshaw, Karen	Royal Victoria Infirmary, Newcastle upon Tyne
Brimlow, George	Queen's Medical Centre, Nottingham
Broadbery, Mary	Royal Victoria Hospital, Belfast
Brown, Lawrence	Royal Hallamshire Hospital, Sheffield
Brown, Malcolm	Royal Liverpool University Hospital
Burton, Linda	Moorfields Eye Hospital, London
Carter, Andrew	Moorfields Eye Hospital, London
Chaieb, Emel	Queens Medical Centre, Nottingham
Chandna, Arvind	Alder Hey Children's Hospital, Liverpool
Chaplin, Caroline	Glasgow Caledonian University
Chen, Sean	Alder Hey Children's Hospital
Constable, Paul	City University, London
Cottrial, Charles	Oxford Eye Hospital
Cumiskey, Jennifer	Cardiff University
Cunningham, Ian	The University of Liverpool
Davidson, Adrian	Royal Victoria Infirmary, Newcastle upon Tyne
Degg, Christopher	Leicester Royal Infirmary
Drizen, Pamela	Moorfield's Eye Hospital, London
Ellison, Fiona	Moorfield's Eye Hospital, London
Farnell, Damien	The University of Liverpool
Fisher, Tony	Royal Liverpool University Hospital
Gonzalez, Pedro	Gartnavel General Hospital, Glasgow
Gonzalez-Martin, Jose	University Hospital Aintree
Gravill, Neil	Lincoln County Hospital
Hagan, Richard	Royal Liverpool University Hospital
Hamilton, Ruth	Yorkhill NHS Trust, Glasgow
Harding, Simon	Royal Liverpool University Hospital
Hardy, Sharon	Great Ormond Street Hospital, London
Harrold, Catherine	Queen's Medical Centre, Nottingham

Hayton, Sam	Great Ormond Street Hospital, London
Hogg, Chris	Moorfields Eye Hospital, London
Holder, Graham	Moorfield's Eye Hospital, London
Jowett, Anne	Queen's Medical Centre, Nottingham
Keating, David	Gartnavel General Hospital, Glasgow
Liasis, Alki	Great Ormond Street Hospital, London
Lim, Chea	Queen's Medical Centre, Nottingham
McBain, Vikki	Moorfields Eye Hospital, London
McCall, Angela	Gartnavel General Hospital, Glasgow
McCulloch, Daphne	Glasgow Caledonian University
McQuiston, Anne	Gartnavel General Hospital, Glasgow
MacKay, Alison	Royal Liverpool University Hospital
Moffatt, Ros	Southport & Ormskirk Hospitals, Merseyside
Mortlock, Katharine	Cardiff University
Needham, Andrew	Leighton Hospital, Cheshire
Neveu, Magella	Moorfields Eye Hospital, London
Newman, Bill	Alder Hey Children's Hospital, Liverpool
North, Rachel	Cardiff University
O'Donnell, Niall	Southport General Infirmary, Merseyside
Parks, Stuart	Gartnavel General Hospital, Glasgow
Parry, Neil	Manchester Royal Eye Hospital
Pridgeon, Mike	The Walton Centre for Neurology & Neurosurgery
Robson, Anthony	Moorfields Eye Hospital, London
Robson, Richard	Diagnosys UK Ltd
Rossiter, Lynne	Royal Hallamshire Hospital, Sheffield
Rudduck, Gillian	Arrowe Park Hospital, Wirral
Sculfor, David	Stoke Mandeville Hospital, Aylesbury
Shafiq, Ayad	Royal Victoria Infirmary, Newcastle
Shahani, Uma	Glasgow Caledonia University
Smith,Richard	Stoke Mandeville Hospital, Aylesbury
Southern, Caroline	Royal Liverpool University Hospital
Thompson, Dorothy	Great Ormond Street Hospital, London
Thorpe, Vivien	Queen's Medical Centre, Nottingham
Wallace, Sharon	Queen's Medical Centre, Nottingham
Wen, Yaqin	Queen's Medical Centre, Nottingham
Willoughby, Colin	The University of Liverpool

OVERSEAS

Bach, Michael	Freiburg, Germany
Barrientos Castaño, Alberto	International Centre of Retinitis Pigmentosa, Cuba
García Báez, Obel	International Centre of Retinitis Pigmentosa, Cuba
Gündoğan, Fatih	Gülhane Military Medical Academy, Turkey
Herrera Mora, Maritza	International Centre of Retinitis Pigmentosa, Cuba
Lubiński, Wojciech	Pomeranian Academy of Medicine, Poland
Nasser, Fadi	Eye and Ear Speciality Hospital, Syria
Norcia, Anthony	Smith-Kettlewell Eye Research Institute, USA
Nusair, Maani	King Khalid National Guard Hospital, Saudi Arabia
Penkala, Krzysztof	Technical University of Szczecin, Poland
Poloschek, Charlotte	University of Regensburg, Germany
Robson, John	University of Houston College of Optometry
Rydberg, Agneta	Karolinska Institutet, Stockholm, Sweden
Stasche, Oskar	Roland Consult, Germany
Westall, Carol	Hospital for Sick Children, Toronto, Canada
Wexler, Alexandra	St. Olav's Hospital, Trondheim, Norway
Wildberger, Hannes	Zurich, Switzerland

Programme

Monday 14th June

10.30 – 13.30 **REGISTRATION & COFFEE**

12.00 – 13.00 **CLINICAL CASES SESSION**
Chairman: Arvind Chandna, Paediatric Ophthalmology, Alder Hey Children's Hospital

13.30 - 13.40 **WELCOME & INTRODUCTION**
Malcolm Brown, Royal Liverpool University Hospital

13.40 - 14.30 **THE HOST LECTURE**
AGE RELATED MACULAR DYSTROPHY (actual title TBA)
Simon Harding, Clinical Eye Research Centre, Royal Liverpool University Hospital

14.30 - 15.00 **TEA & COMMERCIAL EXHIBITION**

15.00 - 16.30 **ORAL PRESENTATIONS (Theme - Retina)**
Chairman: David Keating, Tennent Institute, Glasgow

15.00 - 15.30 **FUNDAMENTALS OF ELECTRO-PHYSIOLOGY IN RETINAL DISEASE**
Holder, G, Dept. Electrophysiology, Moorfields Eye Hospital, London

15.30 - 15.45 **THE USE OF WIDE FIELD MULTIFOCAL ELECTRORETINOGRAPHY (WFmfERG) IN THE ASSESSMENT OF EYES WITH RETINAL VEIN THROMBOSIS (RVT)**
Parks S, Dolan F, Keating D, Gartnavel General Hospital, Glasgow

15.45 - 16.00 **THE ROLE OF ELECTROPHYSIOLOGICAL MONITORING IN THE MANAGEMENT OF BIRDSHOT CHORIORETINOPATHY.**
Robson AG, Pavesio C, Graham EM*, Holder GE
Moorfields Eye Hospital, London & *St Thomas' Hospital, London

16.00 - 16.15 **AN ELECTROPHYSIOLOGICAL AND PSYCHOPHYSIOLOGICAL STUDY OF A CASE OF FUNDUS ALBIPUNCTATUS.**
McBain VA, Hogg CR, Francis PJ, Hykin PG, Holder GE
Moorfields Eye Hospital, London

16.15 - 16.30 **THE LUMINANCE RESPONSE CURVE OF THE PHOTOPIC SINGLE FLASH ERG IN CHILDREN AND INFANTS.**
Chaplin C, Hamilton RE, McCullouch DL, Glasgow Caledonian University, Glasgow

16.30 - 17.30 **BriSCEV BUSINESS MEETING**

18.30 – 22.45 **♪♪ FERRY 'CROSS THE MERSEY ♫**

Second Annual Business Meeting

Monday 14th June 2004
16.30 - 17.30

Agenda

1. Opening by the Chairman
2. Minutes of the 2003 meeting held in Nottingham
3. Report of the Chairman
4. Report of the Secretary
5. Report of the Treasurer
6. Report of the Education Officer
7. Report of the Professional Liaison Officer
8. BriSCEV Bye-Laws
9. BriSCEV Newsletter
10. Elections
11. Future meetings

Programme

Tuesday 15th June

09.00 - 10.30 **ORAL PRESENATIONS (Theme - VEP Assessment of Vision)**
Chairwoman: Daphne McCulloch, Dept. Vision Science, Caledonian University, Glasgow

09.00 - 09.45 **VISUAL EVOKED RESPONSES AS MEASURES OF VISIBILITY**
Norcia A, Smith Kettlewell Eye Research Institute, San Francisco, USA

09.45 - 10.00 **REAL TIME CROSS-CORRELATION IS USEFUL FOR THE OBJECTIVE DETECTION OF TRANSIENT VISUAL EVOKED POTENTIALS**
Bradnam MS, Hamilton R, Yorkhill Hospitals and University Of Glasgow, Glasgow

10.00 - 10.15 **THE EFFECT OF AMBLYOPIA TREATMENT ON GRATING & VERNIER ACUITY DETERMINED BY STEADY-STATE SWEEP VEP**
Chen S, Chandna A, Norcia AM*, Stone D, Pettet M*
Alder Hey Children's Hospital & *Smith Kettlewell Eye Research Institute, San Francisco

10.15 - 10.30 **LOW SPATIAL FREQUENCY DEFICIT IN INFANTS EXPOSED TO ORGANIC SOLVENTS IN UTERO USING VISUAL EVOKED POTENTIALS.**
Westall CA, Till C, Koren G, Rovet JF, Hospital for Sick Children, Toronto, Canada

10.30 - 11.00 **COFFEE & POSTERS**

11.00 - 12.30 **POSTER PARADE**
Moderator: Dorothy Thompson
Great Ormond Street Children's Hospital, London

12.30 - 13.30 **BUFFET LUNCH & POSTERS**

13.30 - 15.00 **ORAL PRESENTATIONS (no theme)**
Chairman: Graham Holder
Dept. Electrophysiology, Moorfields Eye Hospital, London

13.30 - 14.00 **HIGHER-ORDER VEP RESPONSES**
Bach, M
Ophthalmology Dept., Freiburg University Medical School, Germany

14.00 - 14.15 **OPTIMISING THE RECORDING PARAMETERS FOR THE MULTIFOCAL VISUAL EVOKED POTENTIAL**
Wen Y, Thorpe V, Barber C, Dept. Medical Physics, Queens Medical Centre, Nottingham

14.15 - 14.30 **COPING WITH CONVOLUTIONS (OR TRYING TO....)**
Barber C[1], Wen Y[1], Kakigi R[2], Parkkonen R[3]
1 Dept. Medical Physics, Queens Medical Centre, Nottingham
2 National Institute for Physiological Sciences, Okazaki, Japan
3 Helsinki University of Technology, Finland

Poster Parade

11.30-12.30

Each poster presenter to give a 55 second oral summary.

Poster 100 **Non-Vascular Unilateral negative ERG.**
Presented by Anthony Robson

Poster 101 **The Ethanol Electro-oculogram: A species specific response?**
Presented by Paul Constable

Poster 102 **Removal of the frame break-through artefact in PRVEP recordings using a system of wavelet decomposition.**
Presented by Tony Fisher

Poster 103 **Wavelet approach to the PERG analysis and processing.**
Presented by Krzysztof Penkala

Poster 104 **Our results for VEP estimated visual acuities in 174 suspected malingerers / exaggerators.**
Presented by Fatih Gündoğan

Poster 105 **Electro-oculogram in patients with Neurofibromatosis type 1.**
Presented by Wojciech Lubiński

Poster 106 **Electro-retinographic changes in eyes of patients with BRCA 1 gene mutation.**
Presented by Wojciech Lubiński

Poster 107 **Visual stimuli: calibration and clinical testing.**
Presented by George Brimlow

Poster 108 **Disturbed visual system function in methionine synthase deficiency.**
Presented by Charlotte Poloschek

Poster 109 **The Visual Evoked Potential in unconscious children with P. Falciparum malaria.**
Presented by Caroline Southern

Poster Parade

Continued

Poster 110 **Clinical use of the multi-focal ERG - a review.**
Presented by Vivien Thorpe

Poster 111 **Impaired mfERG signals are described not only by an amplitude reduction and an implicit time shift but also by a distortion of the signal shape.**
Presented by Hannes Wildberger

Poster 112 **The Effect of pupil size on the multifocal electroretinogram.**
Presented by Pedro Gonzalez

Poster 113 **Maturation of Pattern Reversal VEPs & skin ERGs in the first year of life.**
Presented by Sharon Hardy

Poster 114 **The visual pathway of children with mucopolysaccharidoses (MPS).**
Presented by Sam Hayton

Poster 115 **Evaluation of the Pattern and Multifocal ERG for Determining the Outcome of PDT for Choroidal Neovascularisation.**
Presented by Magella Neveu

Poster 116 **Clinical, molecular and electrodiagnostic testing in spinocerebellar ataxia: a new cause for a 'negative' ERG.**
Presented by Colin Willoughby

Poster 117 **The effect of a temporary reduction in intraocular pressure on the pattern electroretinogram and visual evoked potential in untreated ocukar hypertension.**
Presented by Katie Mortlock

Poster 118 **Congenital absence of the chiasm: demonstration of an uncrossed visual pathway using monocular flash visual evoked potential.**
Presented by Malcolm Brown

Programme

Tuesday 15th June

Continued

14.30 - 14.45 **1-20 PLATINUM GRID USED TO MAP THE PRIMARY VISUAL CORTEX FOR OCCIPITAL LOBE EPILEPSY PRE-SURGICAL EVALUATION PRIOR TO POSSIBLE SUBPIAL TRANSECTION**

Pridgeon M, Forster A, Eldridge P, Lunney S, Owen M
Department of Neurophysiology, Walton Centre, Liverpool

14.45 - 15.00 **TEMPORAL FREQUENCY TRANSFER FUNCTIONS FOR INFANT VEPs TO LUMINANCE MODULATED LIGHT.**

McCulloch DL[1], Shahani U[1], Hamilton RE[2], Hamilton RAA, Bach M[3]
1 Dept. Vision Science, Caledonian University, Glasgow
2 Yorkhill NHS Trust, Glasgow
3 University of Freiburg, Germany

15.00 - 15.15 **TEA**

15.15 - 16.15 **ORAL PRESENTATIONS ("Nitty Gritty" Issues)**
Chairman: Colin Barber, Dept. Medical Physics, Queens Medical Centre, Nottingham

15.15 - 15.30 **ESSENTIALS OF PHOTOMETRY FOR CLINICAL ELECTRO-PHYSIOLOGISTS**

McCulloch D, Vision Sciences, Caledonian University, Glasgow

15.30 - 15.45 **SIGNAL TO NOISE RATIO IN MULTIFOCAL ERG RECORDS**

Keating D, Chisholm J, Ainslie G, Parks S
Tennent Institute, Glasgow

15.45 - 16.00 **THE BASICS OF DIGITAL FILTERING**

Hogg C, Department of Electrophysiology, Moorfields Eye Hospital, London

16.00 - 16.15 **IMPROVING RECORDING QUALITY BY USING INFRARED VIDEO INSIDE THE GANZFELD STIMULATOR.**

Brown MC, The Department of Clinical Engineering, Royal Liverpool University

16.15 **DEPART**

BriSCEV 2004

Merseyside Maritime Museum
14th – 15th June 2004

The Host Lecture

Monday 14th June
13.40 – 14.30

Age related Macular Dystrophy

Simon Harding
Clinical Eye Research Centre, Royal Liverpool University Hospital

Age related Macular Dystrophy

Simon Harding

Clinical Eye Research Centre, Royal Liverpool University Hospital

Age-related macular degeneration (AMD) affects 9% of the population and 30% of over 75 year olds and is the biggest cause of visual disability in the UK. Subfoveal choroidal neovascularisation (CNV) is the major cause of visual disability in AMD with an estimated 16,000 new cases each year in England and Wales. A range of new techniques to study the disease is being developed including standardised visual acuity (VA) measurements, stereoscopic photography, indocyanine green angiography, optical coherence tomography, techniques of electrophysiology, and image analysis. This expansion has been driven by the introduction of new treatments for the disease.

Confluent laser to CNV significantly reduces severe visual loss but the profound visual loss after treatment of subfoveal lesions and the high recurrence rate has meant its restriction to extrafoveal lesions. Verteporfin photodynamic therapy (PDT) has been shown in large international randomised placebo controlled studies (TAP and VIP) to reduce visual loss in treated patients with CNV. Subgroup analysis showed a greater benefit in predominantly classic lesions with 70% maintaining or improving vision at 24 months ($p<0.001$, number needed to treat (NNT) 3.6) increasing further for lesions with no occult component ($p<0.01$, NNT 2.2). The introduction of PDT into the NHS has been delayed but is showing similar results to those in the early studies. 74% of 171 eyes of 160 patients undergoing PDT in Liverpool for predominantly classic CNV between 1999 and 2001 maintained or improved VA at 12 months compared to 67% in TAP. Further research is required to establish cost-effectiveness and optimise treatment strategies.

Proton beam irradiation for AMD has also been studied and shown to have biological effect on CNV. A prospective randomised controlled trial in Liverpool showed a reduction in frequency of moderate visual loss at 12 months in treated patients compared to untreated controls (mean VA at 12 months: treated 39.2 letters, control 26.2 letters, $p=0.01$). Other treatments being actively studied include macular translocation, transpupillary thermotherapy and anti-VEGF aptamers/antibodies.

A large expansion of research facilities is required to ensure timely introduction of a wide range of new therapeutic modalities for AMD and to move towards the development of combination treatment regimes.

BriSCEV 2004

Merseyside Maritime Museum
14th – 15th June 2004

Presentations

Monday 14th June
15.00 – 16.30

Theme: Retina

Chaired by David Keating
The Tennent Institute of Ophthalmology
Glasgow

Fundamentals of electro-physiology in retinal disease

Graham E Holder

Moorfields Eye Hospital, London

This presentation will address the use of the electroretinogram (ERG) and pattern ERG (PERG) in clinical practice. Clinical cases will be used throughout to illustrate how the tests provide complementary information about visual pathway function.

The electroretinogram (ERG), the massed retinal responses to full-field luminance stimulation, reflects the function of the photoreceptors and inner nuclear layers of the retina. ERGs are recorded from corneal electrodes to stimulation delivered via a Ganzfeld bowl, and manipulation of stimulus parameters and the adaptive state of the eye enables separate evaluation of different cell types and layers within the retina. The pattern electroretinogram, the retinal response to a reversing pattern stimulus, has its origins in relation to ganglion cell function, but, in addition, is “driven” by the macular photoreceptors and also provides an objective index of macular function. The importance of using standardised techniques will be emphasised, but also the need to regard the ISCEV Standard as a minimum data set; some disorders require the additional use of non-standard techniques to establish the diagnosis.

The Use of Wide Field Multifocal Electroretinography (WFmfERG) in the assessment of eyes with Retinal Vein Thrombosis (RVT).

Parks S, Dolan F and Keating D

Gartnavel General Hospital, Glasgow

Aim:
To determine the WF-mfERG responses in eyes with retinal vascular disease caused by central and branch retinal vein occlusions (CRVO and BRVO).

Methods:
WF-mfERG responses were recorded from the eyes of 88 patients diagnosed with retinal vein occlusions within 3 months of the acute event. 56 of the eyes were diagnosed with CRVO and 31 of the eyes had a diagnosis of BRVO. The WF-mfERG first order responses, namely the P1 amplitude and the P1 latency were recorded in the affected eyes and compared to the responses in the 'normal' fellow eye and also compared to age-matched normative data.

Results:
There was a significant difference in both the P1 amplitude and the P1 latency in the affected eyes compared to the unaffected fellow eye and compared to normative data. The P1 amplitude was significantly reduced in the affected eyes and the P1 latency was delayed.

Conclusion:
Retinal vein occlusion can cause considerable distruption to the integrity of the retina and can significantly affect the function of the retina due to ischaemia. Some patients with RVT develop ischemic complications which if not detected early can lead to vitreous haemorrhage, painful glaucoma and blindness. The normal method of assessing these eyes is with an invasive test with potential side-effects called a fluorescein angiography (FFA). The WF-mfERG is a new, non-invasive, investigative tool that is quick to perform that facilitates the objective assessment of retinal function. It can be used to perform serial measurements and does not put the patient at risk of potential serious side-effects that have been recorded with FFA. Results from this study suggest that WF-mfERG has the potential to be a useful investigative tool in the clinical setting.

The role of electrophysiological monitoring in the management of birdshot chorioretinopathy.

Robson AG[1], Pavesio C[1], Graham EM[2], Holder GE[1]

Moorfields Eye Hospital, London[1]; St Thomas' Hospital, London[2]

Aims: To characterise retinal function in patients with birdshot chorioretinopathy before and after treatment with cortico-steroids and/or immuno-suppression.

Methods: Eighteen patients with birdshot chorioretinopathy (BCR) were examined clinically and electrophysiologically. Serial studies were performed on 14 patients.

Results: Most patients presented with characteristic sub-retinal pale spots, were HLA-A29 positive, and had signs of ocular inflammation. Bilateral PERG abnormalities at presentation were common, reflecting macular dysfunction and often associated with macular oedema. Cone-mediated 30Hz flicker ERGs were consistently delayed in one or both eyes of all patients; this was the most sensitive parameter of retinal dysfunction. Scotopic maximal ERG responses were abnormal in thirteen patients; 10 had an electronegative maximal ERG or a reduced b:a ratio in one (4 patients) or both (6 patients) eyes. Single flash photopic ERGs were less often and less severely affected. Photopic ON- and OFF- ERG responses often revealed predominant ON- b-wave abnormalities with relative OFF- d-wave preservation. ERGs improved in treated cases, sometimes preceding clinical signs of recovery. Pattern ERG improvements occurred, possibly reflecting the resolution of macular oedema

Conclusions: Birdshot chorioretinopathy is a chronic inflammatory disorder with a highly unpredictable and protracted clinical course. The ERG data confirm that BCR frequently affects inner retinal function of cone and rod systems. Clinical features were not reliable indicators of functional deterioration or recovery. Objective ERG assessment demonstrated improvement following treatment and provides a reliable method of monitoring treatment efficacy, enabling management decisions to be taken with greater confidence and allowing early initiation or modification of treatment.

An electrophysiological and psychophysical study of a case of fundus albipunctatus with cone dystrophy and negative ERG.

Vikki A McBain, Chris R Hogg, Peter J Francis, Phil G Hykin, Graham E Holder.

Department of Electrophysiology, Moorfields Eye Hospital, London

Purpose: To present phenotypic data and the time-course of ERG normalisation during extended dark adaptation in a case of fundus albipunctatus (FA) with cone dystrophy and negative electroretinogram (ERG).

Methods: A 37 year-old patient presented with non-progressive night blindness from childhood and extensive white dots in his fundus. ISCEV standard ERGs and two-colour dark adaptometry were performed following 20 minutes and overnight dark-adaptation. Additional recordings included the use of coloured stimuli, extended dark adaptation (DA), and a brighter maximal flash (Standard + 0.6LU).

Results: ISCEV standard ERGs showed undetectable rod-specific responses. Red stimulation under dark adaptation gave a detectable cone component but no rod component. The waveform of the responses to increasing intensity white flashes suggested a cone system origin. With the bright stimulus there was an electronegative waveform. After 70 minutes DA both rod-specific and maximal ERGs normalised. Cone ERGs were delayed. Dark adaptometry revealed absent rod-cone interaction and elevated final thresholds with conventional testing, but normal final thresholds following overnight DA. The data from the patient will be compared with those from a patient with FA but no cone system involvement.

Conclusions: Comprehensive recordings in the dark-adapted state allowed novel observations of presumed dark-adapted cone system function resembling the “photopic hill” phenomenon. The normalisation of rod derived ERGs following 70-minutes of DA suggests that a minimal level of rhodopsin is required for rod phototransduction. The value of exceeding the ISCEV minimum ERG protocols is evident.

The luminance response curve of the photopic single flash ERG in children and infants

Chaplin C, Hamilton R E, McCulloch D L

Vision Sciences, Glasgow Caledonian University, Cowcaddens Road, Glasgow, G4 OBA

Purpose: The luminance response function of the b-wave of the single flash photopic ERG waveform shows an increase in amplitude followed by a decrease to a non-zero value where it plateaus. This curve has been termed the photopic hill. Animal studies have indicated the physiology behind this phenomenon to be a reduction in the ON-component amplitudes as well as a delay in the positive peak of the OFF-component at higher intensities. Our aim is to document the existence and characteristics of the photopic hill in young infants. It is hoped that this will contribute to the understanding of the early development of the photopic visual processing in the retina.

Methods: Single flash ERGs were recorded through dilated pupils using a range of flash stimuli from 0.01 cd•s/m^2 to 26 cd•s/m^2, recording with either Burian Allen electrodes or DTL fibres. Signals were scaled appropriately for comparison. Young infants (under 8 weeks of age) were tested while sleeping. ERGs for older infants (1 to 2 years) sedated with chloral hydrate, were obtained from the fellow eyes of patients with unilateral optic nerve hypoplasia, and a comparison group of adults was tested.

Results: The photopic hill in the luminance response function was present in young infants but found to vary from that of adults in both amplitude and peak value. In older infants, no significant variation from adults was noted suggesting that full retinal development had occurred within the first year of life.

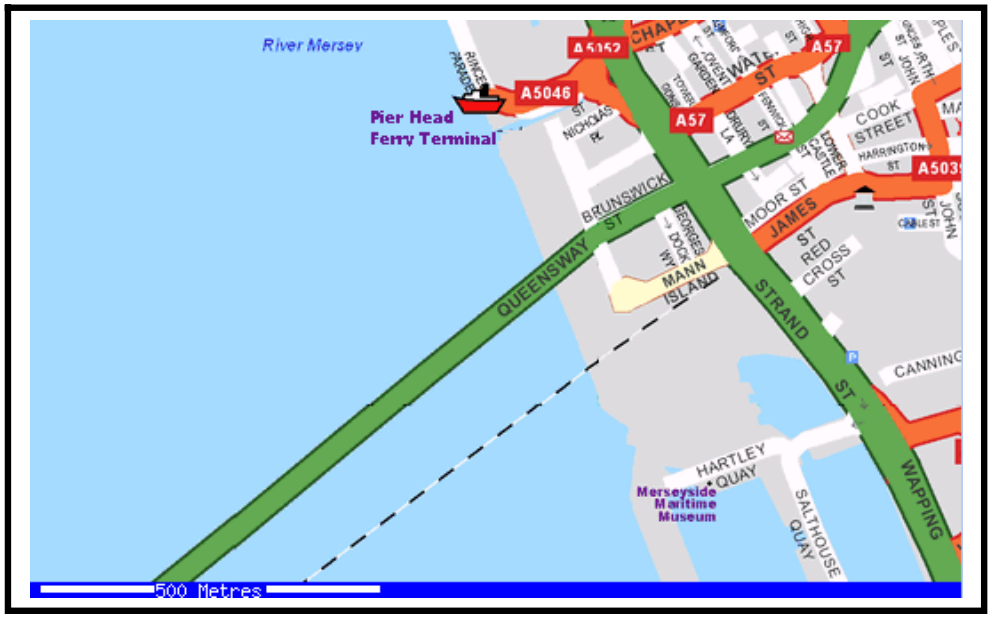
Conclusion: The mechanisms underlying the photopic hill of the b-wave are immature in newborn infants.

Evening Event

Monday 14th June

♪♪ *Ferry 'Cross the Mersey* ♫

18.30 prompt!	**MEET AT PIER HEAD FERRY TERMINAL (see map below)**
19.05	**RECEPTION & DINNER AT WOODSIDE BISTRO**
21.15	**AFTER DINNER CRUISE & DISCO**
22.45	**DISEMBARK AT PIER HEAD**



BriSCEV 2004

Merseyside Maritime Museum
14th – 15th June 2004

Presentations

Tuesday 15th June
09.00 – 10.30

Theme:
VEP Assessment of Vision

Chaired by Daphne McCulloch
The Department of Vision Sciences
Caledonian University, Glasgow

Visual Evoked Responses as measures of visibility

Anthony M. Norcia, Ph.D.

Smith-Kettlewell Eye Research Institute, San Francisco, USA

In many cases, particularly in the pre-verbal population, it is desirable to obtain an electrophysiological measure of stimulus visibility. This lecture will review the history of attempts to link Visual Evoked Response parameters to visibility. Special emphasis will be placed on steady-state methods for estimating visual thresholds, including the swept-parameter technique. I will review the available signal processing methods for detecting the evoked response and for estimating thresholds from stimulus/response functions. Examples of threshold estimation using the sweep method will be given for a range of stimulus types and for various patient populations. Examples will also be presented showing linkage between perception and evoked responses for highly suprathreshold stimuli undergoing rivalry and binocular fusion.

Real time cross-correlation is useful for the objective detection of transient visual evoked potentials

Bradnam MS, Hamilton R

Department of Clinical Physics, Yorkhill Hospitals and University of Glasgow

Purpose: Visual electrophysiological measurements provide useful objective assessment of visual function in children with complex learning difficulties. Despite the value of transient visual evoked potential (VEP) assessment, short subject attention span and high levels of artefact, due to muscle noise or electrical seizure activity, can lead to inaccuracies in measurement and difficulty in interpretation of waveforms. The aim of this study was to apply and assess the use of cross-correlation signal analysis as a tool for objective detection of transient VEPs and also to reduce recording times.

Methods: A cross-correlation algorithm was implemented in real-time and used to compare transient recordings during signal averaging. Alternate sweeps were averaged separately producing two cumulative averages. The cross-correlation algorithm was applied to these two averages after each sweep and the updated cross-correlation coefficient displayed on the operator's screen. The technique was evaluated using data collected from five adults. Binocular recordings were made with/without a pattern-reversal stimulus and with/without myogenic noise artefact. Cross-correlation coefficients were calculated between 50 ms and 200 ms and saved for 10, 20, 40, 60, 100 and 200 averages. One hundred and ninety pairs of data were recorded, and each pair of data was normalised and printed. Three experienced observers, blinded to the cross-correlation coefficients, scored the recordings on a scale of one to five as to whether a response was present or not. These scores and the cross-correlation coefficients were each used to construct receiver operating characteristic (ROC) curves. The ROC curves were then compared to determine their relative performance.

Results: Inspection of the ROC curves showed that the optimum cross-correlation coefficient increased with the number of signal averages as did the test sensitivity and specificity. They also showed that the method of cross-correlation was as good as any of the three experienced observers. The optimum cross-correlation coefficient ranged from 0.24 for 10 signal averages to 0.55 for 100 averages with the sensitivity and specificity ranging from 81% and 100% respectively for 10 averages to 100% for 100 averages.

Conclusion: Alternate signal averaging together with real-time cross-correlation allow efficient use of signal averaging, enabling data to be acquired reliably and rapidly, which is of particular clinical benefit in difficult to test populations.

Acknowledgement: M.S. Bradnam and R. Hamilton were funded by the Chief Scientist Office, Scottish Executive (Grant number K/RED/4/C279) and the Ulverscroft Foundation.

The effect of amblyopia treatment on grating & vernier acuity determined by steady state sweep VEP

Chen S, Chandna A, Norcia AM*, Stone D, Pettet M*

Alder Hey Children's Hospital, Liverpool
** Smith Kettlewell Eye Research Institute, San Francisco, USA*

Purpose

Vernier and Snellen acuity are well correlated in amblyopia and losses on vernier acuity are often larger than grating acuity. This motivates attempts to develop vernier acuity tests for pre-verbal children. One method uses the swept parameter VEP to estimate the acuity threshold by extrapolating the response function to zero signal amplitude. Here we examined the entire response function over large supra-threshold ranges for both vernier and grating sweeps.

Methods

Sweep VEP response functions for 4 stimuli were averaged across 36 amblyopic children (mean age 55 mo) and 19 normal children (mean 64 mo). Grating stimuli were swept between 32 and 2 c/deg using 7.51 Hz pattern-reversal, 3.76 Hz and 15 Hz on-off modulation. The vernier alignment/misalignment grating was swept from 0.5 to 8 arcmin and was presented at 3.76 Hz.

Results

Mean amblyopic optotype acuity was 0.44. Group response functions for all grating acuity measures did not differ between amblyopic and fellow eyes or between normal and amblyopic eyes. In contrast, vernier response functions became progressively different between fellow and amblyopic eyes as the size of the offset increased.

Conclusions

Compared with an analysis based on thresholds alone, it is likely that multivariate analysis of the vernier VEP response incorporating both the slope and the extrapolated threshold of the function will more accurately differentiate the normal from abnormal state, as well as possess more sensitivity and specificity for amblyopia.

Low Spatial Frequency Deficit in Infants Exposed to Organic Solvents in Utero Using Visual Evoked Potentials.

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PURPOSE: Our lab uses visual electrophysiological techniques to investigate visual development when the visual system has been compromised pre-natally or post-natally. Drugs or other toxic insult affects visual system development. A frequency analysis of the VEP response to sweeping contrast and spatial frequencies was used to evaluate prospectively the impact of prenatal solvent exposure on infant visual acuity and contrast sensitivity.

METHODS: All infants were assessed using the sweep VEP during which sinusoidal gratings, alternating at 6Hz, were "swept" across a range of contrasts and spatial frequencies. Contrast sensitivity trials used gratings of fixed spatial frequency (0.5, 2.0 and 5.0 cpd) which were swept once a second in 10 equal logarithmic steps (0.4% to 20% contrast). The contrast threshold was extrapolated from the amplitude at the second harmonic to decreasing contrasts. Visual acuity was extrapolated from amplitudes derived from an 80% contrast grating swept in spatial frequency. Results from 20 infants born to women who were occupationally exposed to solvents during pregnancy were compared with results from 25 non-exposed age-matched control infants. All mothers were recruited from Motherisk, an antenatal counselling service in Toronto, Canada, and exposure levels were estimated in the exposed group using questionnaire data obtained during pregnancy. Infants were assessed at 6 to 24 months of age. Testers were masked to exposure status.

RESULTS: Results showed a significant reduction in contrast sensitivity at low spatial frequencies for solvent-exposed infants compared with controls while no group differences were seen for visual acuity.

CONCLUSION: These findings suggest that maternal occupational exposure to organic solvents during pregnancy is associated with selective deficit in low spatial frequency visual processing in the offspring.

BriSCEV 2004

Merseyside Maritime Museum
14th – 15th June 2004

Poster Parade

Monday 14th June
11.30 – 12.30

Chaired by Daphne McCulloch
The Department of Vision Sciences
Caledonian University, Glasgow

Each poster presenter to give a 55 second oral summary.

Poster 100 **Non-Vascular Unilateral negative ERG.**
Presented by Anthony Robson

Poster 101 **The Ethanol Electro-oculogram: A species specific response?**
Presented by Paul Constable

Poster 102 **Removal of the frame break-through artefact in PRVEP recordings using a system of wavelet decomposition.**
Presented by Tony Fisher

Poster 103 **Wavelet approach to the PERG analysis and processing.**
Presented by Krzysztof Penkala

Poster 104 **Our results for VEP estimated visual acuities in 174 suspected malingerers / exaggerators.**
Presented by Fatih Gündoğan

Poster 105 **Electro-oculogram in patients with Neurofibromatosis type 1.**
Presented by Wojciech Lubiński

BriSCEV 2004

Merseyside Maritime Museum
14th – 15th June 2004

Poster Parade

(Continued)

Poster 106 **Electro-retinographic changes in eyes of patients with BRCA 1 gene mutation.**
Presented by Wojciech Lubiński

Poster 107 **Visual stimuli: calibration and clinical testing.**
Presented by George Brimlow

Poster 108 **Disturbed visual system function in methionine synthase deficiency.**
Presented by Charlotte Poloschek

Poster 109 **The Visual Evoked Potential in unconscious children with P. Falciparum malaria.**
Presented by Caroline Southern

Poster 110 **Clinical use of the multi-focal ERG - a review.**
Presented by Vivien Thorpe

Poster 111 **Impaired mfERG signals are described not only by an amplitude reduction and an implicit time shift but also by a distortion of the signal shape.**
Presented by Hannes Wildberger

Poster 112 **The Effect of pupil size on the multifocal electroretinogram.**
Presented by Pedro Gonzalez

Poster 113 **Maturation of Pattern Reversal VEPs & skin ERGs in the first year of life.**
Presented by Sharon Hardy

Poster 114 **The visual pathway of children with mucopolysaccharidoses (MPS).**
Presented by Sam Hayton

BriSCEV 2004

Merseyside Maritime Museum
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Poster Parade

(Continued)

Poster 115 **Evaluation of the Pattern and Multifocal ERG for Determining the Outcome of PDT for Choroidal Neovascularisation.**
Presented by Magella Neveu

Poster 116 **Clinical, molecular and electrodiagnostic testing in spinocerebellar ataxia: a new cause for a 'negative' ERG.**
Presented by Colin Willoughby

Poster 117 **The effect of a temporary reduction in intraocular pressure on the pattern electroretinogram and visual evoked potential in untreated ocular hypertension.**
Presented by Katie Mortlock

Poster 118 **Congenital absence of the chiasm: demonstration of an uncrossed visual pathway using monocular flash visual evoked potential.**
Presented by Malcolm Brown

Poster 119 **Relative Amplitudes of Oscillatory Potentials recorded using skin (lower lid) electrodes and gold foil scleral electrodes in adults.**
Presented by Richard Hagan

Non-Vascular Unilateral negative ERG

EC Richardson, AG Robson, AHC Koh, PG Hykin, A Calcagni, EM Graham and GE Holder

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Aims: The most common cause of a unilateral negative ERG is central retinal artery occlusion (CRAO) or birdshot chorioretinopathy (BCR). This study examines the clinical and electrophysiological features of patients with unilateral negative ERG who do not have CRAO or BCR.

Methods: As part of a retrospective study, 128 of 2640 patients had negative ERGs. Eleven patients were ascertained with a unilateral negative ERG in whom a vascular aetiology and BCR was excluded. Six of these patients had non-specific inflammatory changes in the eye with the negative ERG. Most presented with symptoms of central retinal dysfunction. In 10 of the 11 patients additional long-duration photopic stimuli were used to test cone ON- and OFF- bipolar cell pathways.

Results: All eleven patients had unilateral negative ISCEV standard maximal ERG responses indicating total or relative preservation of rod photoreceptor function. Seven patients, including 5 with inflammatory signs, had involvement of the cone ON-bipolar pathway on photopic testing with relative or complete preservation of cone OFF-bipolar pathway function.

Discussion: The ERGs in this heterogeneous group of patients predominantly showed post-phototransduction involvement of the ON-pathways in rod and cone systems. Sparing of the cone OFF- pathway was often observed. The majority of patients had signs of previous inflammation and it is speculated that these highly unusual unilateral changes may be mediated via an autoimmune mechanism.

The Ethanol Electro-oculogram: A species specific response?

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Purpose: To determine a suitable *in vitro* model for examining the origins of the Ethanol Electro-oculogram (Eth-EOG)

Methods: Light adapted Bovine Retinal Pigment Epithelium (RPE), *Rana* eyecups and donor human RPE-Bruch's were mounted in modified Ussing chambers. Ethanol: 25 and 125 mM was applied to the apical or basal surface of Bovine RPE or RPE-retina preparations and the Trans Epithelial Potential (TEP) and Resistance (TER) monitored. The electrical potential of *Rana* eyecups were recorded in response to 50 mM ethanol applied to the apical surface as well as alterations in light and dark. Donor human (81yo) RPE-Bruch's was incubated tissue culture media and responses to 0, 10 and 50 mM ethanol applied apically were recorded.

Results: Bovine RPE-Bruch's showed no response to 25 mM ethanol from the apical side (N=6) compared with controls (N=6) at t=0, 10 and 20 minutes after ethanol was added. [Test/Control TEP (mV):TER($\Omega.cm^2$) mean ± SEM] t=0 7.4±1.1/6.6±1.3; 394±63/350±93; t=10 7.7±0.8/6.6±1.4; 410±61:350±93; t=20 7.4±0.9/6.4±1.4; 394±63/343 ± 96 ($p>0.05$). Furthermore, no response to basal 25mM (N=1) or 125mM (N=3) was found. When the retina was in place no response to ethanol with 125 mM (N=2) or 250mM (N=1) was found. *Rana* eyecups showed a decrease in potential of -1.37±0.08 mV (N=4) for 50 mM ethanol whilst a rise in eyecup potential was elicited from 'dark' 0.01cd.m^{-2} to 'light' 530 cd.m^{-2} of +1.43±0.18 mV (N=4). Donor human RPE-Bruch's showed a rise in TEP and a fall in TER in response to 10mM and 50mM ethanol applied to the apical surface when compared to culture media containing 0mM ethanol. [TEP (mV):TER ($k\Omega.cm^2$)] 0mM +3.0:-0.35; 10 mM +6.2:-19.00; 50 mM +9.8:-28.00 at t=60 minutes.

Conclusion: Although light adapted Bovine RPE has been shown to exhibit an ethanol response (Pautler 1994) in green light we could not replicate these findings despite stable TEP's and TER's. Ethanol causes a rise in TEP and fall in TER in human RPE indicating that ethanol acts directly upon the RPE. The lack of response in bovine RPE preparations or rana eyecups indicates that there are some differences between these species and man with respect to the generation of the Eth-EOG.

Removal of the frame break-through artefact in PRVEP recordings using a system of wavelet decomposition

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The superposition of a periodic artefact originating from the frame pulse circuitry of the CRT stimulator is frequently a problem in the recording of the PRVEP.

The effects of this interference can be minimised by de-synchronising ('smearing') the frame presentation sequence with respect to the stimulus-pattern presentation: thus, the interference, uncorrelated with the PRVEP, is reduced by simple averaging. However, this technique is not optimal with regard to recovery of the PRVEP signal and relatively large numbers of averages will required.

An approach is described here in which the ensemble averaged PRVEP signal is transformed into the wavelet time domain using a 7 level Daubechies VIII based decomposition. The time domain appearance of the frame pulse artefact is revealed in the detail (high ordered) levels as a harmonic component at frame rate frequency. The phase and amplitude of this component is identified at each detail level, minimized by a non-linear least squares method, and a series of weights generated. Theses weights represent the complete frame pulse artefact allowing it to excluded in the selective reconstruction of the PRVEP waveform by the inverse wavelet transform.

The presentation illustrates this technique graphically and validates the method for synthetic and recorded waveforms.

Wavelet approach to the PERG analysis and processing

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According to the ISCEV standards, clinical evaluation of the PERG recordings is based on measurement of latencies and amplitudes of particular waves. In many cases it is difficult to localise the peaks precisely, so the method of analysing the PERG parameters in time-domain is inaccurate. This disadvantage affects reliability of the PERG test in clinical practice.

The aim of this study was to demonstrate the possibility of finding features reliable for distinguishing between normal and pathological cases, in Continuous Wavelet Transform (CWT) coefficients domain.

For the purpose of the investigation, 15 normal PERG waveforms and 7 recordings typical of some precisely diagnosed retinal diseases were chosen. The recordings were obtained with the LKC's UTAS-E 2000 system. In the abnormal PERGs, P50 latency was increased (4 waveforms) as well as N95 (3 waveforms). Three different wavelets were used in preliminary experiments, performed with MATLAB software: Morlet, 1st and 2nd (the so-called Mexican Hat) derivative of the Gauss function. Two kinds of wavelets were then chosen for further analysis: Morlet and Mexican Hat. These two functions were most accurate in detecting required features, that is time-scale (frequency) images of N35, P50 and N95 latencies.

Comparison between the proposed method using CWT and traditional, time-domain based analysis, shows that determining the maxima and minima of the PERG waves may be achieved with better accuracy. This improvement becomes especially evident in waveforms with unclear peaks as well as in noisy signals. Thanks to more precise assessment of latencies, separation between normal and pathological waveforms is improved, and, as a consequence, PERG test may gain its efficiency and value in clinical use.

Another approach presented in the paper was based on using Discrete Wavelet Transform (DWT) for initial compression of the PERG signal. This type of pre-processing was performed in order to simplify and optimise the neural network architecture, which was aimed at computer assisted classification of the PERG waveforms.

OUR RESULTS FOR VEP ESTIMATED VISUAL ACUITIES IN 174 SUSPECTED MALINGERERS / EXAGGERATORS

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Purpose: To obtain objective check size-dependent visual acuity estimations in soldiers who are suspected exaggerators/malingerers and who have a tendency to malinger and exaggerate their visual problems in order to have a disability report and other secondary gains.

Methods: The Roland Consult 'Retiport' system was used to perform VEPs. We used a checkerboard pattern reversal stimulus with 5 check sizes, 2°, 1°, 30', 15' and 7' at the contrast level of 99 %, 1Hz reversal rate and 100 averages. The eye to screen distance was 1 m. One hundred and forty two of 174 suspected exaggerators who had another ophthalmic problem (such as strabismus, lens opacity, corneal opacity etc) and were thought to exaggerate, and 32 were without any ophthalmic pathology. Their visual acuities were between no light perception and 0.2. Various methods for simulation examination (mirror test, encouragement, polaroid glasses, fogging, a new optotype chart with optotypes of the same minimum resolution angle, observing the patients behaviour etc.) were used. We made a correlation between check sizes and visual acuities.

Results: One hundred and twelve of 132 suspected exaggerators and all of the suspected pure malingerers were proved to malinger. VEP estimated visual acuities were well-adjusted to visual acuities which we had after simulation examinations.

Conclusion: VEP estimated check size-dependent visual acuities can be used as objective criteria in suspected exaggerators/pure malingerers.

Electro-oculogram in patients with Neurofibromatosis type 1

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Key words: electro-oculogram, neurofibromatosis type 1, retinal pigment epithelium.

Purpose: The electro-oculogram (EOG) is a powerful test to evaluate the functional status of the retinal pigment epithelium (RPE). Clinically detectable changes of the RPE described in neurofibromatosis type 1 (NF-1) patients include combined hamartoma of the retina/RPE and congenital hypertrophy of the RPE. The goal of this study was to determine whether the function of RPE as measured by EOG is also changed in individuals with NF-1.

Patients: Studies were undertaken in 36 patients with clinically diagnosed NF-1 and compared to normal healthy controls.

Methods: Standard EOG and flash ERG recordings were performed in accordance with International Society for Clinical Electrophysiology of Vision (ISCEV) standards.

Results: In NF-1 patients the Arden indexes of the EOG test were significantly higher primarily due to the lower values of dark troughs. Supernormal EOGs (exceeding value of 97.5 percentile from control group) were present in 58 % of NF-1 patients.

Conclusions: Dysfunction of the RPE is the characteristic feature of individuals with NF-1.

The first parts of these studies have been published in Doc Ophthalmol 103: 91-103, 2001.

Electro-retinographic changes in eyes of patients with BRCA 1 gene mutation.

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Key words: BRCA 1 gene mutation, retina, flash electroretinogram

Abstract

Aim: To assess the retinal function in BRCA 1 gene mutation carriers.

Patients and Methods:

Flash electroretinogram (ERG) was studied in 30 unaffected patients (60 yeyes) with constitutional BRCA1 gene mutation.

Results:

I In ERGs, in the maximal response, a-wave was reduced ($p<0.02$). In the cone ssingle-flash response, the amplitude of a-wave was also reduced ($p< 0.04$). In t the oscillatory potentials (OPs), increased amplitude of OP2 ($p< 0.0006$), iiincreased index of OP amplitude (O1+O2+O3+O4) ($p<0.04$), and increased lllatencies of OP1($p<0.05$), and OP3 ($p<0.004$), and OP4 ($p<0.03$) were oobtained.

I **Conclusions**

Dysfunction of rods, cones and inner retinal layers is present in asymptomatic ccarriers of BRCA 1 gene mutation.

The first part of this studies have been published in Ophthalmic Res 2003; 35: 1164-169

Visual stimuli: calibration and clinical testing

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Regular calibration of recording and stimulus parameters is an essential part of quality assurance for a clinical electrophysiology service. ISCEV rightly emphasises this through its published guidelines which were updated last year. The guidelines contain much useful background technical information and suggested methodology and protocols.

In practice, the aim of any calibration scheme is to ensure that the parameter in question is checked, and, if appropriate, adjusted such that there is unlikely to be any significant change between calibrations. If a significant change does occur, then one may need to review the clinical tests carried out over the preceding interval.

A critical question here is what is a significant change for each parameter? Although there is some discussion on this in the ISCEV guidelines, there is little quantitative information, and in reality this apparently simple question raises some interesting and complex issues.

To answer the question, we need to look at the possible effect of uncertainties in the calibration on clinical outcomes. For a particular test measure (for example, a response amplitude) we can derive an uncertainty based on the uncertainty in the calibration. If this does contribute significantly to the overall uncertainty, we need to consider how the test measure is interpreted to provide diagnostic or monitoring information.

A number of examples for the stimulus and adaptation levels for the flash ERG and EOG are discussed to illustrate this.

Disturbed visual system function in methionine synthase deficiency

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***Background*:** Isolated functional methionine synthase deficiency occurs in the cblE and cblG defects of methylcobalamin metabolism and is one of a number of causes of severely elevated plasma homocysteine. Clinical features include changes which are mainly of a neurological nature and also functional restriction of the visual system manifested as loss of visual acuity and nystagmus. As yet, the origin and pathogenesis of impaired vision has not been explained.

***Patient and Methods*:** We investigated a patient who was proven by means of complementation analysis using cultured fibroblasts to belong to the cblG complementation group. Homocysteine and methionine levels were /3µM and 14µM respectively after 4 months of receiving betaine monohydrate, folate and hydroxycobalamine. Ganzfeld-electroretinograms (ERG) and flash visual evoked potentials (VEP) were recorded over a period of four years. The first ERG was recorded after the patient had already received treatment for 10 months.

***Results*:** Amplitudes of all ISCEV standard responses were below normal (rod response 43% below normal, equals an absolute reduction to 37µV, standard combined response (SC) b-wave 55%/120 µV, OPs 90%/5µV, cone response b-wave 70%/35µV, 30 Hz flicker response 90%/7µV). Rod function declined on follow-up examinations. Implicit times were slightly prolonged (SC b-wave 6 ms, OPs 2 ms, cone b-wave 2 ms, 30 Hz flicker 4 ms) or fell in the range of normal. The sequence of negative and positive peaks of the flash VEP was prolonged. On re-examination after a period of two years severe deformation of the response rendered implicit time measurements of the typical troughs and peaks impossible. However, responses were reproducible.

***Conclusions*:** This is the first report of detailed investigations of the visual system in a patient with isolated methionine synthase deficiency in this case due to the cblG defect. Reduced oscillatory potentials hint at microvascular damage to the retina through homocysteine. Decreased photoreceptor function as well as ganglion cell loss as suggested by pathological flash VEPs might reflect a cytotoxic impact of homocysteine on neurons of the visual pathway. However, ERG and VEP changes might not be attributable to elevated homocysteine levels alone since visual function is normal in other diseases that cause severe hyperhomocysteinaemia.

The Visual Evoked Potential in Unconscious Children with *P. Falciparum* Malaria

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1. *St. Paul's Eye Unit, Royal Liverpool University Hospital*

Purpose: To investigate the visual evoked potential (VEP) in unconscious children with *P. falciparum* malaria, a common cause of death in Africa.

Methods: VEPs were carried out in Malawi during the 1999 peak malaria season. Children were included in the study if they had *P. falciparum* malaria and reduced consciousness (Blantyre Coma Score (BCS) $\leq$ 4). Children with BCS $\leq$ 2, with no other obvious cause of coma, were defined on clinical grounds as having cerebral malaria (CM). Initial VEPs were performed after stabilising the patient and commencing treatment. To investigate optimal VEP protocols for future use, three traces were recorded with different stimulus parameters. Where possible, VEPs were repeated daily until the child recovered full consciousness (BCS 5).

Results: The initial traces of 40 children (35 CM) were included in the study and serial traces were obtained in 30 of these. Mean VEP latency was greater on admission than either on day 1 or at BCS 5 (paired t-test, $p<0.05$) for all three trace protocols. There was a positive correlation between VEP latency on admission and parasite count (Spearman's rank correlation, $p<0.05$) for all trace protocols.

Conclusions: Unconscious children with *P. falciparum* malaria have increased VEP latency on admission compared to day 1 or on recovery and the increased latency is positively correlated with blood parasite count. VEP recordings are quick and reproducible and may find a place in assessing cerebral function in severe malaria.

Clinical use of the multifocal ERG – a review

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The multifocal ERG (mfERG) is an electrophysiological test that can provide a topographical map of retinal function. Following a developmental phase, mfERG testing has been used clinically for approximately one year.

A retrospective study of mfERG results obtained over a twelve-month period from 139 patients referred for electrophysiological testing was carried out. Patients were categorised by condition, where possible, following a review of medical records. Results were then grouped by condition and individual findings compared. For a subset of conditions, patient results were compared to findings published in the literature. The aim of this review was to gain an improved clinical understanding of disease patterns in mfERG results and also to assess the level of agreement between local results and those in the literature.

The conditions covered in this review included retinitis pigmentosa, Stargardt's disease, congenital stationary night blindness and macular holes. Typical findings in these conditions are presented and the agreement with the literature discussed. Where there are differences between local results and those in the literature possible reasons for this are suggested.

As an additional item, the future promise of the related technique of the multifocal VEP (mfVEP) in the objective measurement of glaucomatous field defects will be briefly discussed.

Impaired mfERG signals are decribed not only by an amplitude reduction and an implicit time shift, but also by a distortion of the signal shape.

Hannes Wildberger, Wilson Njoh, Johannes Fleischhauer

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Purpose: To report in a clinical study about electrophysiological signal delay and signal deformation (mfERG) in a family with a retinal dystrophy.

Methods: Conventional ERG, mfERG and mfVEP were recorded in a family (5 members, two of them were clinically affected).

Results: mfERG signals of the two affected family members were markedly delayed, broadened and deformed. The conventional ERG`s (cone responses, flicker) were delayed too. mfVEP`s on the other hand were not much delayed (altitudinal halves were compared).

Conclusions: Bioelectical retinal signals may be severely deformed and delayed, but the finally resulting retino-cortical time may not be much affected. That's also known from the conventional VEP which is not much delayed in maculopathies. The retinal signal delay seems to be rather an expression of an intraretinal dysfunction which is basically not affecting the speed of the processing stream towards the cortex. There is a variety of different types of signal deformation in the retinal centre or near periphery: pure amplitude reduction, for example, with normal implicit time and normal signal form; broadening and slow decay of the delayed signal with or without amplitude reduction. The clinical relevance of such features is open for discussion.

The Effect of pupil size on the multifocal electroretinogram

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Gartnavel General Hospital, Glasgow

Purpose: To investigate the effect of changing the pupil diameter on the amplitude and latency of the multifocal electroretinogram.

Methods: Multifocal electroretinograms were recorded using a custom built electrophysiological system. An array of sixty one empirically scaled hexagons was used to stimulate the visual field. The duration of overall recording period was eight minutes, segmented into sixteen intervals each lasting thirty seconds. An amplifier gain of 100,000 with an ADC digitization rate of 1200Hz and a dual high/low pass filter of 3-300Hz and 10-100Hz was used. Four normal subjects were recruited and both eyes were tested. Mydriasis and miosis were obtained with tropicamide (1%) and pilocarpine (1%) respectively. Pupil diameters between 9mm and 1mm were measured. All patients were emmetropic.

Results: For a change in pupil diameter of 8mm there was a drop in amplitude in some cases greater than 50% (amplitude 53nV at 8mm to 25nV at 1 mm). Also there was an increase in latency in some cases as much as 8ms in the central 40° (39ms at 8mm to 47ms at 1mm.)

Conclusions: Pupil size has significant effects on both amplitude and latency of multifocal electroretinograms and should be measured carefully to provide accurate interpretation of results.

Maturation of Pattern Reversal VEPs & skin ERGs in the first year of life.

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The Tony Kriss Visual Electrophysiology Unit,
Ophthalmology Dept,
Great Ormond Street Hospital for Children, London, WC1N 3JH.

Purpose: To establish normative ranges for the amplitude and latency of flash and pattern reversal VEPs & flash ERG recorded from non-sedated infants up to 1 year of age.

Methods: 135 healthy full term infants, (age range 1 week -1 year), were recruited via local maternity departments & well baby clinics. 18 infants had serial recordings, and a total of 178 recordings were performed on 135 infants. Pattern reversal VEPs were recorded from 3 occipital electrodes to a range of check sizes, (400'-6.25') when possible. Skin electrodes positioned within 1cm of the lower lid margin were used to record flash ERGs when possible in response to flashes from a hand held Grass strobe, (1-3Hz, grass intensity 1-8 & coloured filters).

Results: Pattern reversal VEPs show a rapid decrease in latency in the first 6 months of life, and remain stable from 6-12 months. Growth curves are presented to show latency & amplitude changes of the p100 with age and are compared to previous published studies.

ERGs from skin electrodes are shown to cone, mixed rod/cone and predominantly rod mediated stimulation. Growth curves to reflect changes in amplitude & latency with age are presented. These mirror changes described in ERGs elicited by different techniques.

Success rates and limitations of testing will also be discussed.

Conclusion: These preliminary visual electrodiagnostic response norms for infants provide a reference for other laboratories dealing with alert young patients.

The visual pathway of children with mucopolysaccharidoses (MPS).

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The Tony Kriss Visual Electrophysiology Unit, Ophthalmology Department, Great Ormond Street Hospital, London WC1N 3JH

Purpose: Visual compromise can be significant in the natural history of MPS disease. ERG and VEP findings in these patients are reviewed to help elucidate the nature and variability of visual dysfunction in childhood.

Introduction: MPS diseases are a group of inherited metabolic disorders resulting from genetic defects in the lysosomal enzymes necessary to metabolise glucosaminoglycans (GAGs). Partially degraded GAGs accumulate in connective tissue and body organs. This leads to permanent, progressive cellular damage, which varies in severity depending upon the specific enzyme defect.

Patients: We reviewed 46 patients, age range 13 months –18 years 1month (median 6 years 1month) in subtypes, MPSI: 26, MPSII: 8, MPSIII: 2, MPSIV: 5, MPSVI: 5.

Methods: Mixed rod/cone ERGs were recorded from skin electrodes (natural pupils) and FVEPs from occipital electrodes, in response to bright flashes presented BEO in scotopic conditions. Pattern reversal VEPs were recorded in response to various checksizes presented on a 28 degree TV monitor.

Results: Normal ERG, FVEP and PVEPs were recorded in 41% (19) of MPS patients. Normal ERG /Preserved FVEP / Abnormal PVEP in 33% (15) (corneal involvement). Abnormal ERG /Preserved VEP in 9% (4) (retinal dysfunction-mainly extra-macular). Preserved ERG /Abnormal FVEP and PVEP in 17% (8) (post-retinal involvement).

Conclusion: These visual electrophysiological findings provide insight into the various effects of GAG accumulation within the visual system of infants and children with MPS.

Evaluation of the Pattern and Multifocal ERG for Determining the Outcome of PDT for Choroidal Neovascularisation.

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Purpose: To assess photodynamic therapy (PDT) treatment for choroidal neovascularisation (CNV) associated with age related macular degeneration (AMD) using Pattern ERG (PERG) and multi-focal ERG (mfERG).

Methods: Thirteen patients with predominantly classic CNV underwent PDT. Patients were followed at 3 monthly intervals for 2 years. Additional testing was done 2 weeks post treatment. PERGs and mfERGs were performed on all patients. Patients were characterised into 3 groups according to visual outcome, 'improve', 'stable' and 'worse'.

Results: The amplitudes of P50 and N95 increased following PDT, whereas the latencies lengthened. p1 density and n1 amplitude from mfERG ring 1 increased following treatment. Treatment had no effect on n1 latency, but p1 latency shortened. Pre- and post-treatment differences in the PERG were proportionate to the mfERG changes in ring 1.

6/13 patients showed improvement in P50 amplitude by 2 years that correlated strongly with an improvement in visual acuity (R=0.86). p1 density and n1 amplitude from rings 1 and 2 only showed significant correlation with visual acuity (P=0.01). p1 density and n1 amplitude from rings 1 to 4 of the treated eye were significantly lower than the fellow eye at 2 years (P<0.001). p1 latency from the treated eye, was significantly shorter than the fellow eye from ring 1 only and n1 latency was significantly longer from ring 2 only.

Patients with poor visual outcomes had a greater amplitude difference between treated and fellow eyes prior to treatment, whereas those with improved vision had the smallest amplitude difference. ('worse' 49% amplitude difference; 'improve' 39% amplitude difference).

Conclusions: The PERG and mfERG provide an effective objective method of assessing the effects of PDT on central retinal function in patients with CNV. An improvement in the amplitude of the PERG and mfERG was

Clinical, molecular and electrodiagnostic testing in spinocerebellar ataxia: a new cause for a 'negative' ERG.

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Purpose: To define the ocular phenotype including electrodiagnostic testing in a family with spinocerebellar ataxia (SCA).

Methods: Three members of a UK family with SCA had an ocular and neurological assessment. Electrodiagnostic testing (ERG, VEP, and EOG) was performed according to the standards of the International Society for Clinical Electrophysiology of Vision (ISCEV). Serum copper, caeruloplasmin, vitamins B12 and E levels were determined to exclude a metabolic basis for the SCA. Mutational screening for SCA (SCA 1, SCA 2, SCA 3, SCA 6 and SCA 7) and Friedreich's Ataxia (frataxin gene) was performed to identify the number of triplet repeats or expansion mutations.

Results: All members of the family had neurological features consistent with SCA. The ocular phenotype consisted of retinal pigment mottling with reduced ERGs to all modes of stimulation. In particular, all had 'negative' ERG to maximal mixed rod/cone mediated stimulation. Serum copper, caeruloplasmin, vitamins B12 and E levels were normal in all three family members. Genetic testing for SCA 1, SCA 2, SCA 3, SCA 6 and SCA 7 and Friedreich Ataxia was normal.

Conclusion: This represents the first report of retinopathy associated with SCA not caused by an expanded trinucleotide repeat in the gene encoding ataxin-7 (SCA7), and also the first report of a negative ERG associated with SCA. SCA should be considered in the differential diagnosis of negative b-waves.

The effect of a temporary reduction in intraocular pressure on the pattern electroretinogram and visual evoked potential in untreated ocular hypertension.

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Purpose: Ocular hypertension (OHT) exists when intraocular pressure (IOP) is raised above normal limits, but visual field and optic nerve head parameters remain normal. There is evidence, however, that some level of neural dysfunction may be present, as both the pattern electroretinogram (PERG) and pattern visual evoked potential (PVEP) have been found to be affected in OHT. The question of whether this dysfunction represents an IOP-dependent reversible loss or permanent damage remains unanswered and this study aims to answer this by investigating the effect of a temporary reduction in IOP on the PERG and PVEP in OHT.

Methods: IOP (OBF tonometer), visual fields (SITA standard 24-2, Humphrey Field Analyser) and PERGs and PVEPs were measured in 18 untreated OHT subjects. Monocular PERGs (DTL fibre) and PVEPs (15% above inion) were recorded to high contrast 19' checks reversing at 4 reversals per second (rps) and 16 rps. Data were collected on two separate days; once with natural untreated IOP and once following a temporary reduction of IOP. This was achieved by instilling a single drop of 0.5% Iopidine and/or 1% Azopt in the test eye two hours prior to examination.

Results: A significant reduction in IOP was seen two hours after the instillation of medication (mean (±SD) untreated IOP 24.0 (±4.6) mmHg; treated IOP 15.4 (±4.7) mmHg; $p<0.001$ paired t-test). There was no significant change in visual field parameters after IOP reduction. The amplitude and implicit time of the PERG (4 and 16 rps) were unaltered after IOP reduction. The P100 implicit time (untreated 108.8 (±6.6) ms; treated 107.7 (±7.1) ms; $p=0.015$, Wilcoxon Signed Ranks Test) was significantly decreased following IOP reduction.

Conclusions: At present, these data do not conclusively suggest the presence of reversible damage in this group of OHT subjects. It may be necessary to reduce IOP over a longer term in order to reveal such a reversal in OHT. This is currently being investigated in a group of OHT and primary open angle glaucoma subjects commencing long term medical treatment.

This research is supported by the Wellcome Trust.

Congenital absence of the chiasm: demonstration of an uncrossed visual pathway using monocular flash visual evoked potential

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Purpose: To demonstrate flash visual evoked potential testing to diagnose absence of the chiasm. A two year old girl was referred at Alder Hey Children's Hospital, Liverpool with nystagmus associated with head oscillation and poor visual acuity recorded at 6/19 in each eye. The patient was referred for possible cone dystrophy.

Methods: Flash VEP was employed with two-channel recording between Fz and O1, O2 (placed 4cm each side of Oz).

Results: Responses to flashes with binocular viewing showed symmetrical responses over each lobe of the visual cortex. However, when each eye was patched in turn, stimulation of the right eye produced responses similar to the binocular response on the right occipital electrode with a poorly discernable response over the left occipital electrode. The responses were reversed when the left eye was stimulated. This is the opposite to the results obtained in preceding patients under similar test conditions with albinism in which the better response was obtained over the contra-lateral hemisphere and an diminished response from the ipsi-lateral hemisphere. We discuss here the possible explanation that the patient had a reduction in the proportion of fibres decussating at the chiasm compared with the increased decussation in the albino patients.

An MRI of our patient subsequently showed the absence of the chiasm.

Conclusions: In this case the absence of the chiasm was first suggested by the VEP findings. To our knowledge this is one of only a few cases with congenital absence of the chiasm detected in this way. There were no prior signs of a midline defect or other intracranial abnormality.

Relative amplitudes of Oscillatory Potentials recorded using skin (lower lid) electrodes and gold foil scleral electrodes in adults.

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Purpose: To investigate the observation that Oscillatory Potentials (Ops) as recorded using skin (lower lid) electrodes seem larger in relation to the underlying ERG A & B waves, than when recorded using gold foil scleral electrodes.

Methods: 7 adult volunteers had photopic flash ERG tests with recordings made simultaneously from lower lid skin electrodes and gold foil scleral electrodes. Flash intensity of 2.0cd.m^{-2}.s was used. Recordings were made only from one eye. Pupils were not dilated, and background light was 30cd/m^2. Amplifier filter bandwidth was 0.3-300Hz.

The standard ERG was split into low frequency and high frequency components (Oscillatory Potentials) by off-line filtering of 0.3-80Hz and 80-300Hz. Ratios were determined for skin and gold foil electrode B-wave amplitude in the frequency ranges 0.3Hz-80Hz and 0.3-300Hz. For the faster waves a summation of the amplitude of the Ops1-4 was made and a ratio calculated.

Results: In every case the gold foil/skin electrode amplitude ratio was smaller at the higher frequencies than the lower frequencies. Ratio for 0.3-80Hz mean 6.72, SD 2.21, for 0.3-300Hz mean 5.82, SD 1.73, and for 80-300Hz mean 3.46, SD 1.13, all three of these groups are significantly different from each other at the 0.05 level for paired t-Test.

Discussion: The amplitudes of OPs recorded using skin electrodes have been discussed elsewhere with various possible explanations. The higher bandwidth used for OPs will emphasise the EMG contamination of the signal and this can be seen on some of the examples. This could result in higher amplitude estimates for OPs using the methods employed here. Since skin electrodes are more commonly employed when testing children and young babies it has been suggested that children have relatively higher OPs. A third possibility is the orientation of the dipoles generating the OPs differs from the generators of the A&B waves.

Conclusion: We found consistently higher OP amplitudes in adults using skin electrodes than with gold foil scleral electrodes, when the amplitudes were compared to the A-B wave amplitudes.

BriSCEV 2004

Merseyside Maritime Museum
14th – 15th June 2004

Presentations

Tuesday 15th June
13.30 – 15.00

No theme

Chaired by Graham Holder
The Department of Electrophysiology
Moorfields Eye Hospital, London

Higher-order VEP responses

Michael Bach

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I will describe various experiments that go “beyond the classical stimulus”. In the present context I classify responses to flash and pattern onset/reversal as “low-level”. Responses specific for colour and motion I will classify as “mid-level”, because they need markedly more complex stimulus paradigms, and cortical processing goes beyond local contrast. Finally, “higher-order” VEP responses have been reported for texture-segregation, face recognition, symmetry, binocular rivalry, and multistable perception.

I will expand on two specific examples, namely texture segregation, which is now showing promise as a clinical tool in addition to its basic research relevance, and on multistable perception.

Texture segregation is a basic mechanism in separating figure from ground. Using parallel processing, it “looks for” gradients in the following visual dimensions: luminance, orientation, spatial frequency, temporal frequency, motion, disparity and very few more. Evoked potentials associated with these mechanisms were isolated (“tsVEPs”) and proved to be relatively independent of the visual dimension, suggesting that tsVEPs originate “higher up” the visual processing chain. The contrast transfer function of tsVEPs is parvocellular-based, even if motion is the segregator. Recent findings in traumatic brain-injured patients suggest that tsVEPs can reveal damage not obvious in “standard” VEPs, as tsVEPs tap a higher processing stage.

Multistable perception is seen in the well-known “Necker Cube”, where the percept reverses the front-back orientation on prolonged viewing. To study the mechanisms causing these endogenous reversals, we developed a paradigm to time-lock on these endogenous events without relying on the widely jittering reaction times. This revealed a small but highly significant positivity at 120 ms, restricted to the occiput, when the perceptual reversal takes place. This suggests that the mechanisms underlying perceptual reversal occur about 200 ms before perceptual awareness is established.

Optimising the recording parameters for the multifocal Visual Evoked Potential

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Purpose: For some individuals and some stimulus locations, the mfVEP may be too small to measure. This limits its application in detecting small local field defects. Some studies have been done to increase the signal-to-noise ratio (SNR) by using multiple channels, but little has been done in optimising the temporal stimulus parameters. The aim of this study was to investigate the effect of the stimulus reversal frequency to the response of the pattern reversal mfVEPs and to get the optimal feasible recording parameters for clinical investigation.

Methods: 6 subjects aged between 27 and 61 years with no known abnormalities of the visual system participated in the study. Two channels of recording were obtained simultaneously. The signal was amplified by 100,000 times and band-pass filtered between 3 and 100 Hz. The stimulus used was a dartboard pattern with 60 sectors, each sector containing 16 checks, 8 white and 8 black. The pattern was reversed at different frequencies by adjusting the number of frames in each m step. The second order kernel local responses were extracted using VERIS 4.7 software.

Results: The response waveform changed in shape, latency and amplitude with different temporal frequencies of the stimulus. By slowing the rate of stimulation, the response waveform became more like the waveform of conventional VEP and the response became larger, but the latency increased.

Conclusions: Our study showed that slowing the rate of stimulation increased the amplitude of the signal. The recording parameters of m=14 and 2 frames in each m-step were the best combination in order to get bigger responses and good quality of records in 7 minutes.

Coping with Convolutions (or trying to . . .)

Barber C[1], Wen Y[1], Kakigi R[2], Parkkonen R[3]

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Purpose: To determine the extent to which the deleterious effects of cortical convolutions on the VEP can be overcome through use of the multifocal technique.

Methods: Multifocal stimuli were generated, using a variety of patterns (checkerboard, dartboard, graduated checkerboard), and stimulus field sizes of 16^0 or 32^0. Three subjects with no known abnormalities of the visual system participated in the study. In order to obviate the effects of high skull impedance, and to improve detection of responses from more peripheral areas of the visual field; MEG, rather than EEG, signals were recorded. Multi-channel systems were used: 37-channel in pilot experiments and 306-channel in subsequent measurements.

Results: Clear multifocal visually evoked magnetic fields (mfVEFs) were recorded in all subjects. The distribution of responses across the stimulated field varied between patterns in the expected way. For a given pattern, the response waveform distribution varied considerably between subjects, and was strongly dependent on detector location.

Conclusion: Multifocal stimulation appears to have the capability of activating areas of cortex small enough that they may be considered planar, and thus give rise to simple responses. Multiple detectors can track the differing cortical convolutions between individuals. Further work is necessary to determine whether electrical signals (mfVEPs) can be recorded with an adequate signal-to-noise ratio and adequate spatial sensitivity.

1-20 platinum grid used to map the primary visual cortex for occipital lobe epilepsy pre-surgical evaluation prior to possible subpial transection

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Aim: To use Flash and Pattern reversal visual evoked potentials to map out the visual cortex on a 1-20 platinum cortical grid.

Method: A 20 contact platinum grid was placed over a lesion in the occipital cortex. Pre-operative structural and visual fMRI were obtained. The patient was connected to EEG telemetry for 7 days. She experienced 11 typical seizures with visual aura and EEG changes from the grid contacts corresponding to the lesion location.

Flash visual evoked potentials were recorded from each contact and used to map the primary visual cortex using P100 amplitude. Pattern reversal stimulation using 31 minute per side check size at a distance of 1 metre were performed similarly and a second P100 amplitude map was produced for the grid area.

Results: The two visual evoked potential cortical maps were produced and used to locate the primary visual cortex. The maximal amplitude corresponded to the calcarine fissure identified by structural MRI though disagreeing with activation since by fMRI.

Conclusion: The cortical maps were correlated with the data obtained from telemetry and MRI. The lesion was in close proximity to the primary visual cortex. Seizure onset was also within this region. Although resection was possible for seizure control the patient was not prepared to accept the substantial risk of visual deficit, nor even the reduced risk for sub-pial transections.

Temporal Frequency Transfer Functions for Infant VEPs to Luminance Modulated Light.

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1 *Vision Sciences, Glasgow Caledonian University*
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3 *Ophthalmology, University of Freiburg*

Purpose: Young infants, particularly those at risk for neurological damage may be unable to maintain adequate fixation for pattern VEP recordings. Flash VEPs, while easily recorded in these populations, are remarkably insensitive due to high inter-subject variability. The aim of the present study was to investigate the normal maturation for the luminance VEP over a range of temporal frequencies.

Methods: VEPs were recorded from the occipital scalp in a group of healthy infants (between 15 days and 11 months of age) and in healthy adults. The stimuli were 12 temporal frequencies of sinusoidally modulated flicker ranging from 2 to 90.6 Hz in half octave steps. Maximal luminance was 100 cd/m^2 and modulation depth was 40%. The frequency spectra were analysed off line.

Results: In adults, VEP amplitude at the stimulus frequency (H1) showed a broad band-pass function peaking between 8 and 16 Hz. The amplitude of the first harmonic (H2) showed a monotonic decrease with temporal frequency of the stimulus. Both H1 and H2 was detectable for temporal frequencies up to 62.5 Hz.

Infants also showed a band pass function for H1 of the luminance modulated VEP and a low pass function for H2 but both functions were shifted to lower frequency ranges. For infants under 9 weeks of age, H1 of the VEP was optimal for stimuli between 3 and 8 Hz and the VEP was not detectable above 11 Hz. By 11 months of age, the VEP to luminance modulation for both H1 and H2 functions is located approximately one octave below those for adults.

Conclusions: VEPs to luminance-modulated light demonstrate substantial immaturities in young infants supporting the hypothesis that temporal processing in the visual system matures substantially in the first year of life.

BriSCEV 2004

Merseyside Maritime Museum
14th – 15th June 2004

Presentations

Tuesday 15th June
15.15 – 16.15

Theme: Nitty Gritty Issues

Chaired by Colin Barber
The Department of Medical Physics
Queen's Medical Centre, Nottingham

How big is your flash? Essentials of photometry for clinical electrophysiologists

McCulloch Daphne L.

Department Vision Science, Glasgow Caledonian University, Glasgow

Even at the basic level, photometry is a complex measurement system for light involving energy, time, area, direction and receptive properties of the human eye. The photometric stimuli used in clinical electrophysiology, particularly, brief, uniform full-field flashes are not prominent in other photometric applications. In addition, both incorrect and obsolete terms and units appear regularly in the literature.

The aim of this presentation is to give a concise review of photometric quantities and units that apply to ISCEV standard tests and to clinical research.

A literature survey will be used to illustrate the current state of completeness and accuracy when reporting the use of photometric stimuli in clinical testing and applied research.

Finally, specific topics of interest to the clinical electrophysiology of vision will be discussed. These include considerations of flash integration time, pupil size, other ocular dimensions and the Stiles-Crawford effects.

Signal to Noise ratio in multifocal ERG records.

David Keating, Jennifer Chisholm, Gillian Ainslie and Stuart Parks

Gartnavel General Hospital, Glasgow

The quality of an electrophysiological waveform can be quantified by measuring the signal to noise ratio.

Several methods used to measure the SNR of multifocal responses have been described in the literature. The most common methods include a repeat run with the stimulus covered to obtain an estimate of the noise and use of a time-window later in the response window to obtain an estimate of the noise. The advantages and disadvantages of these methods and a new method which makes use of the mathematical properties of m-sequences will be discussed.

Finally, recommendations for optimising the SNR of multifocal responses in clinical practice will be presented.

Digital filters – a brief introduction

Chris Hogg

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Conventional electronic filters used in electrophysiology are based around networks of resistors and capacitors. Digital filters do not require these components, the waveforms being manipulated by a computer program. These digital filter algorithms have been used conventionally to modify data post acquisition. However, with the advent of low cost, high speed computing, it is now possible to utilise digital filtering as an alternating to conventional analogue designs.

The advantages and some possible complications will be discussed, along with the underlying theory of operation.

Improving recording quality by using infrared video inside the Ganzfeld Stimulator

Malcolm Brown

Clinical Engineering Dept., Royal Liverpool University Hospital

Purpose: To investigate the benefits of using infrared video inside the Ganzfeld stimulator for recording ERG, EOG and flash VEP.

Methods: A CCD camera was fitted to a Ganzfeld stimulator to view the face of the patient through a pinhole. Infrared LEDs were fitted facing inwards to reflect from the coating of the bowl onto the face of the patient. The patient's face was viewed from a TV monitor on the operator's console and a video recorder and microphone were employed to log the essential events of the session.

Results: A sequence of video examples has been assembled which show the deviations in the behaviour of patients from that desired, and I will discuss their effects on the validity of the results. I will also show how the view of the patient enabled these problems to be corrected by directly instructing the patient. A number of the examples are with children and show that considerable improvement in behaviour within the bowl can be obtained if the operator has a good view of the patient's eyes and the recording electrodes.

Conclusions: Considerable improvement in recording quality, and in confidence in the results, can be achieved by the use of direct video viewing of a patient who has their head within the Ganzfeld bowl. Examples are where the patient looks away from the fixation light, where they close or partially close their eyes in response to the stimulus (particularly flicker), where the electrodes become displaced, and in the case of the EOG where they do not follow the instructions or deliberately ignore them.