10th Annual Meeting

NHS Grampian

1495 UNIVERSITY OF ABERDEEN

British Society for Clinical Electrophysiology of Vision

Monday 10th & Tuesday 11th September 2012

Medico-Chirurgical Building

Foresterhill, Aberdeen

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BriSCEV 2012 Scientific Program

Monday 10th September

BriSCEV Course	**Assessing structure and function in inherited retinal disease**
$9^{15} – 10^{00}$	Electrophysiology fundamentals – Dr Ruth Hamilton
$10^{00} – 10^{45}$	Testing paradigms - working towards a cohesive approach Dr Tony Robson
$10^{45} – 11^{15}$	Coffee break
$11^{15} – 12^{00}$	Electrophysiology, autofluorescence and diagnosis of inherited retinal disease – Miss Noemi Lois
$12^{00} – 12^{45}$	Lunch & commercial exhibition

BriSCEV Conference

Session One	**Chairs: Dr Vikki McBain & Mr Richard Smith**
$12^{45} – 13^{00}$	Welcome and Introduction – Dr Vikki McBain
$13^{00} – 13^{45}$	Guest Lecture: Miss Noemi Lois – “Clinical application of electrophysiology and autofluorescence imaging”
$13^{45} – 14^{45}$	Oral presentations “Retina – structure & function”
$15^{00} – 15^{15}$	Coffee break & commercial exhibition

Session Two	**Chairs: Mr Chris Hogg & Dr Dorothy Thompson**
$15^{15} – 15^{45}$	Commercial presentations
$15^{45} – 16^{30}$	Guest lecture: Dr Zofia Miedzybrodzka – “The genetics of eye disease”
$16^{30} – 17^{30}$	BriSCEV business meeting

Evening social

$17^{30} – 18^{00}$	Coach transfers from hotels & Med Chi to Curl Aberdeen
$18^{00} – 19^{00}$	Welcome drink, soup and safety brief at Curl Aberdeen
$19^{00} – 20^{30}$	Curling Bonspiel
$20^{30} – 23^{00}$	Dinner at Curl Aberdeen

Tuesday 11th September

Session Three	**Chairs: Mr David Sculfor & Dr David Keating**
$9^{00} – 10^{00}$	Clinical case presentations
$10^{00} – 10^{45}$	Guest lecture: Professor David Lurie "MRI - past & present"
$10^{45} – 11^{45}$	Poster parade, coffee break & commercial exhibition

Session Four	**Chairs: Prof. Colin Barber & Dr Ruth Hamilton**
$11^{45} – 12^{45}$	Oral presentations "Travelling eyes"
$12^{45} – 14^{00}$	Lunch & commercial exhibition

Session Five	**Chairs: Drs Lawrence Brown & Magella Neveu**
$14^{00} – 15^{00}$	Oral presentations "Physics & physiology"
$15^{00} – 15^{30}$	Prize giving & farewell tipple
15^{30}	Conference ends

Sunday 9th September

"Early arrivals"

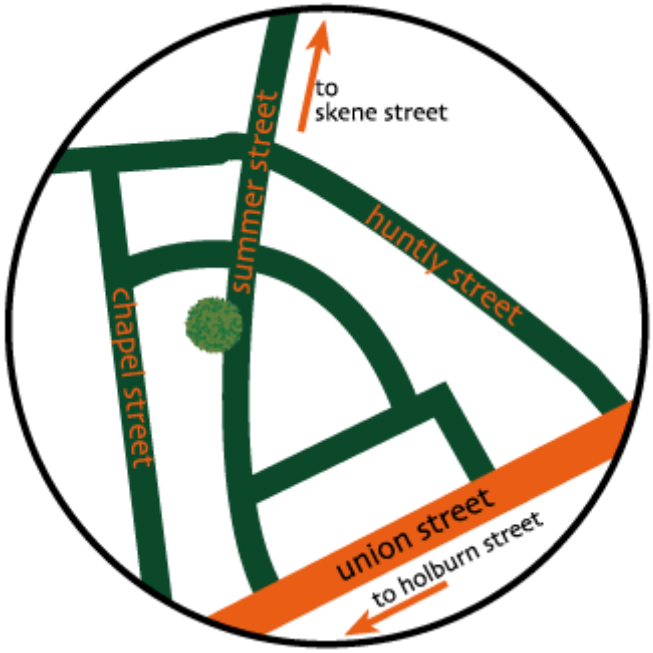
Meal at local restaurant

The Braided Fig

http://www.thebraidedfig.co.uk/welcome.html

7 pm for 7.30pm

The braided fig is located in the heart of Aberdeen's city centre at 39 Summer Street. Conveniently situated we can be easily reached directly from the west end of Union Street.



Monday 10th September

Evening event

Curl Supper

http://www.curl-aberdeen.co.uk/

6 pm for 6.30pm

Curl Aberdeen, Eday Walk is located off the Lang stracht, if approaching from North Anderson Drive. Coaches will transport you to and from Curl Aberdeen for the curl supper.

Bus 1: Departs 5.30 pm Holiday Inn Express and then 5.45 pm Copthorne and Bus 2: Departs 5.30 pm The Atholl and then 5.45 pm Medico-Chirurgical building. Bus 2 will also pick up at the Best Western Summerhill Inn Suites but it is only a 20 minute walk to Curl Aberden if you would prefer.

The same buses will do the reverse route after the curl supper, departing Curl Aberdeen approx 11.15pm.

Welcome

Dear friends

I am delighted to welcome you to Aberdeen for the 10th annual BriSCEV meeting. The Medico-Chirurgical building is a historical part of NHS Grampian and the University of Aberdeen. It was founded by students in 1789 and evolved into a postgraduate Medical Society in 1811. In 1920 the Society held a special meeting where Professor Matthew Hay outlined his scheme for co-ordinating the Aberdeen Hospitals and clinical University Departments on a common site. This resulted in the modern hospital and medical school complex we now have at Foresterhill.

On visiting Aberdeen, you will have the opportunity to see some of the Oil Capital of Europe, a title held since the discovery of North Sea oil in the 1970s. Aberdeen is also known as the Granite City due to the high mica contents of the quarried grey granite used in Aberdeen's buildings, which can sparkle like silver in the sunlight. Today visitors find Aberdeen a thriving city which boasts both old and new attractions in and around the city centre and surrounding picturesque countryside.

During BriSCEV you will be able to experience the unique sport of curling. Curling is thought to have been invented in medieval Scotland as early as February 1541 with Kilsyth Curling Club claiming to be the first club in the world, constituted in 1716 and still in existence today. Outdoor curling was very popular in Scotland between the 16th and 19th centuries, as the climates provided good ice conditions every winter. Scotland is home to the international governing body for curling, the World Curling Federation and in 1998 it became an official sport in the Winter Olympic Games.

Sponsors

We would like to thank all of our sponsors for their generous support. Please take time to visit them during the conference and if you get your sponsor card signed each time, you could win a bottle of whisky. Their contributions help to reduce the cost of your meeting.

Slàinte Mhath
Dr Vikki McBain

Day 1

Session One

Chairs: Dr Vikki McBain & Mr Richard Smith

Guest Lecture: Miss Noemi Lois

Consultant Ophthalmic Surgeon & Clinician Scientist

"Clinical application of electrophysiology and autofluorescence imaging in inherited retinal disease"

Electrophysiology and conventional fundus autofluorescence (AF) imaging are diagnostic techniques widely used in the evaluation of patients with inherited retinal diseases. The more recently described near infrared autofluorescence (NIA) has also been shown to be a promising tool to help clinicians in the management of patients with chorio-retinal diseases. In this talk the practical advantages and disadvantages of each of these modalities will be reviewed. Furthermore, the way in which electrophysiology, AF and NIA can complement each other to better provide a diagnostic and prognostic assessment of patients with inherited retinal diseases will be also discussed.

Notes

Oral presentations

"Retina – structure and function"

Phenotypic and genetic variability in patients with clinical and/or ERG features of "fundus albipunctatus"

Robson AG[1,2], Sergouniotis PI[1,2], Mukhopadhyay R[1,2], Moore AT[1,2], Holder GE[1,2], Webster AR[1,2]

Moorfields Eye Hospital, 162 City Road, London, U.K.[1] and University College London Institute of Ophthalmology, 11-43 Bath Street, London, U.K.[2]

Purpose: To characterise phenotypic and genetic variability in patients with clinical and/or ERG features of "fundus albipunctatus"

Methods: Thirteen patients from 12 families with nyctalopia and fundus and/or ERG features of "fundus albipunctatus" were ascertained. Fundus autofluorescence (AF) imaging was performed in 9 and spectral domain optical coherence tomography (OCT) in 7 patients. Full-field ERG testing included standard and prolonged periods of dark adaptation. The coding region and intron-exon boundaries of *RDH5* and *RLBP1* were analysed in eleven families; *RPE65* was additionally examined in 1 patient.

Results: Visual acuity was 6/9 or better in all but one eye of a patient with adult-onset central scotomata. Most fundi had white dots extending into the mid-periphery; 1 patient had normal fundi. Background AF was reduced in 9 of 9 cases. OCT revealed dome-shaped lesions corresponding to the fundus white dots and extending between the RPE and IS/OS band. The rod ERG (DA 0.01) was undetectable in 7 and ranged up to 47% of normal in others. The bright flash ERG (DA 11.0) a-wave showed mild-moderate reduction in 11 of 13; the waveform was electronegative in 8. After prolonged DA rod ERGs normalised in 9 of 11and were moderately subnormal in 2 others. Bright flash ERG a- and b-waves normalised in 8 of 12. Photopic 30Hz ERGs were delayed in 7 and subnormal in 4 of 12 cases. Biallelic mutations were found in *RDH5* (N=7 families), *RBPL1* (N=1) and *RPE65* (N=1).

Conclusions: Clinical and/or electrophysiological features consistent with "fundus albipunctatus" can result from mutations in *RDH5, RLBP1* or *RPE65*. Reduced autofluorescence is a consistent feature in keeping with disrupted retinoid recycling. Electrophysiology and an integrated approach to diagnosis are essential.

Novel concentric petaloid reflex in patients with foveal hypoplasia

Cornish CS, McBain VA, Reddy AR.

Eye Out-patient Department, Aberdeen Royal Infirmary, Foresterhill AB25 2ZN

Purpose: Foveal hypoplasia is a condition that is commonly associated with conditions such as aniridia and albinism. We present a case series of six patients with ocular albinism and one with aniridia, all having foveal hypoplasia, who have a concentric petaloid reflex on infra-red reflectance. To our knowledge, this has never been documented in the literature.

Methods: Case series of six ocular albinism and one aniridia patients is presented. All cases had visual acuity measured, electrophysiology, OCT, autofluorescence (AF), near-infrared and infrared reflectance (IRR). All images will be presented, and compared with age-matched control.

Results: Electrophysiology was normal in all cases (ERG, PERG and VEP). 5-channel VEP confirms chiasmal misrouting in all ocular albinism cases. A speckled pattern is seen in AF in all cases, foveal hypoplasia or fovea plana on OCT, and a concentric petaloid reflex on IRR. OCT was not possible in the aniridia patient due to nystagmus, but the reflex was visible on IRR, confirming that it is a useful tool in clinical diagnosis.

Conclusion: The concentric petaloid macular reflex that our study describes is a consistent finding in foveal hypoplasia where there is complete loss of the foveal pit. Based on our case series, IRR can be a useful imaging modality in the investigation of suspected foveal hypoplasia and albinism.

Electroretinograms in Duchenne Muscular Dystrophy

D A Thompson[1], V Ricotti[2], H Jägle[3], A.T Moore[1], F Muntoni[2]

1. Clinical and Academic Department of Ophthalmology, Great Ormond Street Hospital for Children, London, UK.
2. Dubowitz Neuromuscular Centre, Department of Neurosciences and Mental Health, Faculty of Population Health Sciences, University College London, UK.
3. University Eye Clinic, Regensburg, Germany.

Purpose: The central nervous system involvement in Duchenne Muscular Dystrophy, (DMD), is complex and related to the location of the mutation in the DMD gene, and the effect that the mutation has on the expression of brain specific dystrophin protein (Dp) isoforms. Scotopic ERG changes described in DMD have been attributed to altered expression of the retinal isoforms of Dp. Our study aimed to expand the retinal phenotype association with DMD genotype.
Methods: 16 DMD patients, mean age 9.5 years, (range 4-15 years) under the care of the neuromuscular clinic had electroretinography. They had an range of genotypes: seven had mutations towards the 5' end of the dystrophin gene involving exons 3-13, predicted to affect the full length dystrophin flDp427, seven patients exons 44-57, affecting flDp427 and Dp260, and two patients at the 3' end involved exon 70, affecting expression of flDp427, Dp260 and Dp71. Full field ganzfeld flash ERGs were recorded with DTL corneal electrodes after 20 minutes dark adaptation to a series of scotopically presented single flashes of strengths 0.001- 200 cd.s/m2 and to 15Hz flickering flashes ranging from -3 to 0.5 log scot troland/s. After 10 minutes light adaptation ERGs were recorded to photopic flash strengths (0.3-10 cd.s/m2) and prolonged photopic on 240ms-off flashes. Oscillatory potentials were isolated from scotopic and photopic ERGs by filtering between 100-300Hz. In addition skin ERGs to a hand held flash stimulus were recorded to a range of flash strengths under scotopic and photopic conditions to promote predominantly rod driven b-waves, maximal scotopic a-waves, mixed rod cone a- and b-waves, photopic cone a- and b-waves and 30Hz flicker responses. ERG component amplitudes and time to peaks were compared with age matched normative data.
Results: 'Negative' scotopic ERGs with reduced b-wave amplitudes were recorded in all patients with mutations involving exons 44-57, one patient with mutation at exon 8-13 and both patients at exon 70. The 15Hz scotopic flicker lacked a slow rod pathway response in these cases. The scotopic oscillatory potential, OP2, was reduced in all patients with mutations of exons 44-57, and in one patient exon 8-13. In contrast the photopic OP2 was reduced in patients with deletions upstream 5' of exon 30, and preserved in those patients in whom scotopic OP2 was attenuated. Photopic ERG a:b-wave amplitude ratios were reduced variably across the patient group, including those with 5' mutations in whom scotopic a:b ratios had been normal.
Conclusions: Our data highlight a strong association of ERGs abnormalities with mutations downstream of exon 30, the promoter region for Dp260. The scotopic 'negative' ERG phenotype does not associate uniquely with specific retinal isoforms of dystrophin and an interesting exception involves exon 8-13 of the dystrophin gene.

Clinical and electrophysiological characteristics of Occult Macular Dystrophy

Murphy, R[1]; Hogg, CR[1]; Robson, A[1,2]; Holder, GE[1,2]

1Electrophysiology Department, Moorfields Eye Hospital, London, UK
2Institute of Ophthalmology, University College London, London, UK

Aim: To review the clinical and electrophysiological findings in a cohort of patients with occult macular dystrophy (OMD). OMD usually presents with reduced central vision but fundus examination and full field electroretinography (ERG) are normal. The disease relates to mutation in RP1L1.

Methods: Seven patients with molecularly confirmed OMD were examined. All patients underwent ERG, pattern ERG (PERG), and multifocal ERG (mfERG) to incorporate the ISCEV Standard responses. mfERGs were recorded using the Retiscan System (Roland Consult) using a 61 hexagonal array. The latency and amplitude of the P1 and N1 components were analysed for central and para-central areas. The findings were compared to those of fundus autofluorescence (AF) and spectral-domain optical coherence tomography (OCT).

Results: Visual acuity ranged from 0.0 to 1.0. Full-field ERGs were normal in all patients. Pattern ERG P50 was subnormal in 4 of 7 cases (one case showed unilateral involvement only). Central multifocal ERGs were reduced in 5 cases, including one patient with a normal pattern ERG. Fundus AF images were normal in 4 patients but showed irregular foveal changes in 3 patients. OCT revealed focal changes in 4 of 7 patients.

Conclusion: The study demonstrates the importance of electrophysiological examination of macular function, and of OCT and AF structural imaging, in the diagnosis of OMD. Common misdiagnoses, in relation to the normal fundus appearance, include optic nerve disease, amblyopia or functional visual loss.

LIGHT-ADAPTED ERGS IN PRETERM INFANTS AT RISK OF RETINOPATHY OF PREMATURITY (ROP)

Daphne L McCulloch (1), Helen Mactier (2), Lesley Farrell (1) and Ruth Hamilton (3)

1 Vision Sciences, Glasgow Caledonian University, Glasgow, UK.
2 Neonatal Unit, Princess Royal Maternity Hospital, Glasgow
3 Dept of Clinical Physics, Univ of Glasgow & the Royal Hospital for Sick Children, Glasgow

Purpose: The VitAL study, a clinical trial of early high dose vitamin A supplementation in infants at risk of ROP, has reported that scotopic retinal sensitivity in infants at risk of ROP is improved by early supplementation with high-dose vitamin A1. We now report features of light-adapted ERGs in this population and examine associations with the stage of ROP.
Study design: In a double-blind, randomised controlled trial, eligible infants born before 32 weeks' gestation and/or <1501 g birth-weight were stratified by gestation and randomised to receive additional intramuscular vitamin A 10,000IU three times weekly from day two for minimum of two weeks or until establishment of oral feeding. The primary outcome measure was based on cone-corrected, dark-adapted retinal rod sensitivity measured by ERG at 36 weeks' postmenstrual age (PMA).
Methods: ERGs were recorded using a contact lens electrode with the infants swaddled and placed beneath a ganzfeld stimulator. After the dark-adapted ERG protocol1, infants were light-adapted (30 cd/m2) for 10 minutes for a full-field ERG protocol including a luminance-response series, ERGs at 3 Hz (single) and 30 Hz (flicker) with both ISCEV standard (2.6 cd•s/m2) and strong flash (10 cd•s/m2) stimuli as well as ERGs to abrupt luminance onset and offset.
Results: Plasma retinol was higher in supplemented infants at 7 and 28 days after birth ($p < 0.001$ and 0.03 respectively) but this difference was no longer evident at 36 weeks' PMA. Fifty-seven infants did not develop ROP, 13 developed stage 1, four stage 2 and seven infants developed severe ROP (stage 3+) requiring treatment with laser photocoagulation. As expected, low birth weight and short gestation were strong risk factors for presence and severity of ROP as was postnatal illness measured by duration of oxygen support and length of hospitalisation (rank correlations, $p<0.01$). The b-waves of ERGs measured at 36 weeks PMA (before any ROP treatment) were smaller in those who developed ROP (n=12) (rank correlations $p<0.05$ for light-adapted standard, strong and sudden onset stimulation and for dark-adapted red flash). Five of the seven infants who developed severe ROP continued to require positive airway pressure and could not complete ERG testing; light-adapted ERGs in the other two infants were markedly diminished to all stimuli.
Conclusions: Smaller ERG amplitudes at 36 weeks' PMA were associated with the development of ROP and in two infants who developed severe ROP light-adapted ERGs were markedly reduced. However, the ERG protocol with testing before term age could not be completed in the majority of infants who developed severe ROP.

1. Mactier et al. 2012 J Paediatrics, 160, 954-959.

Notes

Session Two

Chairs: Mr Chris Hogg & Dr Dorothy Thompson

Commercial presentations

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Kelvin Vision launched the Multifocal Imager 3GEN in 2009 and currently developing further products in the field. The Multifocal Imager 3GEN meets and exceeds the ISCEV standards for Multifocal Electroretinography and is the culmination of 16 years of research with experience in over 7,000 patients.

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Session Two Continued

Guest Lecture: Dr Zosia Miedzybrodzka

Medical Genetics, University of Aberdeen
&
Clinical Genetics, NHS Grampian

"The genetics of eye disease"

The genetic basis of eye disease is unfolding rapidly, and clinical geneticists are being asked more and more for advice about genetic implications of eye disease. Zosia Miedzybrodzka is a practising clinical geneticist who will reflect on the role of genetics clinics and testing in families commonly presenting to genetics services, focussing on advantages and limitations for individuals and their families.

Notes

Day 2

Session Three

Chairs: Mr David Sculfor & Dr David Keating

Clinical case presentations

Notes

Guest Lecture: Professor David Lurie

Aberdeen Biomedical Imaging Centre, University of Aberdeen

MRI - past & present

Magnetic Resonance Imaging (MRI) scanners are now found in hospitals around the world, where they use strong magnetic fields and pulsed radiowaves to generate high-resolution scans of soft tissues. This talk will provide an overview of the basic physics behind MRI, in the context of the history of the technique's development, with particular emphasis on the role played by scientists at Aberdeen University. It will conclude with a description of physics-based MRI research being carried out today in Aberdeen.

Magnetic Resonance Imaging was first proposed by US scientists Raymond Damadian and Paul Lauterbur in the early 1970s as an imaging technique based on Nuclear Magnetic Resonance (NMR, as found in chemistry laboratories). Subsequently, Aberdeen University's Department of Bio-Medical Physics and Bio-Engineering, then headed by Professor John Mallard, was one of the first research groups in the world to demonstrate the feasibility of MRI. The team, led by Dr. (now Emeritus Professor) Jim Hutchison, constructed a basic bench-top MRI system in the mid-1970s, then went on to build one of the world's first human whole-body-scale scanners. Initial images were low-resolution and suffered from artefacts, but in 1980 Hutchison and his team made a breakthrough with the "spin warp" imaging method which, for the first time, produced diagnostic-quality images. The world's first clinical MRI scan of a patient's body was carried out later that year using Aberdeen University's "Mark I" scanner.

More than 30 years later, physicists and engineers at Aberdeen University are continuing to conduct research into novel types of MRI scanner. In particular, we are investigating a new method called "Fast Field-Cycling MRI", which promises to reveal hitherto invisible NMR-based information about disease processes, especially those involving malformed proteins in the body.

Notes

Session 3

Poster Presentations

AN UNUSUAL PHOTOPIC ERG SHOWING INNER RETINAL ISOLATED CONE SYTEM DYSFUNCTION

Andrew Carter[1], Magella Neveu[1,2], Graham Holder[1,2]

1 Moorfields Eye Hospital, London

2 Institute of Ophthalmology, UCL, London

Purpose : To present unusual electrophysiological findings in a 22 year old female referred for investigation of gradually deteriorating central vision over several years.

Methods : The patient underwent a full clinical examination including fundus photography, OCT and autofluorescence imaging (AF). Initial electrophysiology was performed in November 2004; there were 3 subsequent visits, the most recent being in February 2012. All tests were performed to incorporate the ISCEV standards. Pattern Electroretinogram (PERG), Pattern visual evoked potential (PVEP) and Electroretinogram (ERG) were recorded on the first visit; PERG, ERG and Multifocal ERG (MFERG) were recorded on the second and third visit; PERG and ERG on the fourth visit.

Results : Initial visual acuity was reduced in both eyes (RE 6/9, LE 6/12); retinospcopy confirmed bilateral myopic astigmatism. Dilated fundal exam was normal. PVEP was normal from both eyes. PERG P50 component peak time was delayed with normal amplitudes. DA 0.01 ERG and DA 11.0 ERG showed normal rod system function. LA 3.0 showed a reduced b-wave and normal a-wave. LA 3.0 30Hz had an unusual appearance and delayed peak time. The findings were therefore in keeping with generalised inner retinal cone system dysfunction. There was no clinically significant change in any ERG parameter on subsequent visits. MFERG responses from both eyes were of simplified waveform with no clear localised areas of loss of function. In February 2012 the patient reported trouble adapting to bright light and dazzle from bright lights at night; retinal appearance, OCT and AF were within normal limits.

Conclusion : The electrophysiological findings in this patient showed marked cone system dysfunction which appeared to be stationary over an 8 year period. In the context of a cone dystrophy and in our experience this is uncommon. The case demonstrates the value of electrophysiological testing in patients who have cone dystrophy but normal clinical examination, and who are often assumed to have optic nerve disease.

ETHAMBUTOL INDUCED OCULAR TOXICITY, A CASE REPORT

Y. Wen[1] and CS. Lim[2]

1 Department of Medical Physics, 2 Department of Ophthalmology

Queen's Medical Centre Campus, Nottingham University Hospital NHS Trust

Purpose: Report a case of subclinical Ethambutol induced ocular toxicity with recovery confirmed by electrodiagnostic tests.

Methods: The pattern reversal VEP (PRVEP), pattern ERG (PERG), full-field flash ERG (FERG) and multifocal ERG (mfERG) were recorded to ISCEV standards. These tests were performed 1 month and 7 months after cessation of Ethambutol treatment.

61 year old lady was referred with "suspected Ethambutol toxicity". She presented with a 4 month history of blurring of her central vision OU. She had been on Ethambutol 900 mg/day (about 15 mg/kg/day), Rifampicin 600mg/day and Azithromycin 250 mg/day for mycobacterium avium-intracellulare infection (MAI) for the last 19 months.

Pre-treatment (baseline) visual acuity (VA) was (LogMar, aided) -0.04 OD and -0.1 OS. One month after stopping Ethambutol her VA was 0.26 OD and 0.12 OS. 7 months after stopping treatment, VA improved to 0.16 OD and -0.08 OS.

Results: Initially the PRVEP and the PERG were abnormal OU. The full-field flash ERG was within the normal range OU but amplitudes of the light-adapted 3.0 ERG and 30 Hz flicker responses were relatively reduced OS. The mfERG was also relatively reduced OS though the ring average responses were still within the normal range OU.

At 7 months post-cessation, the PRVEP and PERG showed significant improvement OU. The mfERG was also improved centrally OS. However the FERG did not show improvement and the photopic responses remained smaller OS than OD.

The electrodiagnostic results confirmed the diagnosis of Ethambutol ocular toxicity and repeat testing showed improvement of both optic nerve and retinal function, though not full recovery.

Conclusions: Ethambutol optic neuropathy is more widely recognised than retinopathy. This case demonstrated that Ethambutol toxicity can affect both the central and peripheral retina, too. Therefore mfERG and full-field flash ERG should be performed to check retinal function when Ethambutol toxic neuropathy is suspected. This case clearly demonstrated the value of electrodiagnostic testing in the detection of Ethambutol ocular toxicity particularly in this subclinical case, in the monitoring of progression and recovery.

The value of mfERG in unilateral visual loss following road traffic accidents

Anne Jowett, Sharon Wallace, Yaqin Wen

Department of Medical Physics, Queen's Medical Centre Campus, Nottingham University Hospital NHS Trust

Purpose: Case series to demonstrate the use of mfERG in investigating visual loss following road traffic accidents (RTA).

Methods: A retrospective case series of three patients presenting with unilateral visual loss following RTA were referred for electrodiagnostic tests.
The mfERG and PERG were recorded for all cases. The pattern VEP, multifocal VEP and full-field flash ERG were also recorded for some of the cases.

Case 1: 19 year old male was referred with suspected a partial avulsion of right optic nerve following RTA. He presented with a central blurring vision 2 days after RTA. His VA was CF OD and 6/5 OS. Electrodiagnostic tests were carried out 3 months after RTA.

Case 2: 16 yr old female was referred with unexplained reduced vision in OD. She presented to Eye Casualty four days after RTA with VA CF OD, 6/5 OS. Electrodiagnostic tests were carried out 3 weeks after RTA.

Case 3: 35 year old female was referred with suspected optic nerve dysfunction. She presented to Eye Casualty one month after RTA with a sudden onset of blurring vision and "pain" OD. Her VA was 6/18 OD and 6/5 OS. Electrodiagnostic tests were carried out 5 months after RTA.

Results: mfERG and PERG were reduced in OD and normal in OS. The mfERG revealed a marked amplitude reduction of central responses OD in all three cases.
Conclusion: The mfERG demonstrated there was a retinal contribution to the visual loss in all three cases and was useful to identify the actual area of the retina affected.

THE VARIATION IN CONE ISOLATING ERGs ACROSS THE RETINA IN PATIENTS DIAGNOSED WITH RETINITIS PIGMENTOSA

John Maguire [1], Neil Parry [1, 2]

1. University of Manchester 2. Manchester Royal Eye Hospital

In retinitis pigmentosa (RP) it has been previously shown that on some occasions the cone ERG may be absent due to signal cancellation as a result of disease-related phase shifts as opposed to retinal degeneration. In this study we investigate reasons why the cone ERG is sometimes preserved in RP patients. We speculate that this may be related to the ratio of long (L) to medium (M) wavelength sensitive cones, such that the cone types of individuals with a colour vision deficiency or a high L:M ratio may not cancel each other out completely. We tested a group of normal subjects and a group diagnosed with retinitis pigmentosa. Colour vision testing was performed using Ishihara and the City test. Psychophysical testing (L:M ratio), full field Ganzfeld ERG and cone isolating 30Hz flicker L and M driven ERG's were performed on all subjects. The cone isolating stimulus was delivered using the previously published "sharksfin" method using various circular as well as centre ablated annular stimuli at eccentricities of 10o-70o. We measured the phase and the amplitude of the first harmonic using Fourier analysis.

Preliminary data: comparative outcomes of visual acuity and electrophysiology findings in patients undergoing treatment for Birdshot chorioretinopathy

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Eye Out-patient department, Aberdeen Royal Infirmary, Aberdeen.

Aims: To investigate the visual acuity and electrophysiology findings in patients undergoing different treatment regimes for Birdshot chorioretinopathy.

Methods: 14 patients with Birdshot chorioretinopathy (BCR) were diagnosed and treated at Aberdeen Royal Infirmary between 2006 and 2012. 10 of the 14 patients had had repeat electrophysiology testing to monitor their response to treatment. The patients were divided into 3 subgroups based on their treatment regime: 1. IV methyl prednisolone with oral steroids and + immunosuppressants or 2. oral steroids with immunosuppressants, 3. oral steroids only. Case notes were reviewed along with visual acuities (Snellen) and the results of the electrophysiology tests: pattern electroretinogram (PERG) and electroretinogram (ERG). The outcome of treatment in terms of vision and stability of electrophysiological findings were assessed within the 3 patient subgroups.

Results: There were 6 male and 8 female patients included in the study with a median age of 56 (range 46-67). All patients presented with characteristic sub-retinal pale spots and 8/14 were HLA-A29 positive (remaining awaiting serology). The most common electrophysiological abnormalities seen in the patients at first visit were (1) a reduced PERG in 12/14 patients, (2) a delayed cone 30 Hz ERG implicit time (LA 3.0) in 12 of 14 patients and (3) a reduction in the scotopic rod ERG b-wave (DA 0.01 + DA 3.0) seen in 7 out of 14 patients. At the most recent follow-up a reduced PERG was seen in 6/10 patients, a delayed cone 30 Hz ERG implicit time (LA 3.0) in 5/10 patients and a reduction in the scotopic rod ERG b-wave (DA 0.01 + DA 3.0) was seen in only 3 out of 10 patients. At the most recent follow up, 20/28 eyes maintained 6/12 or better visual acuity (range 6/5-6/12) and only 2/28 eyes had less than 6/60 visual acuity. Representative electrophysiological findings and visual acuities for a patient in each subgroup will be presented.

Conclusions: Objective electrophysiological assessment and evaluation of the visual function is essential to demonstrate improvement following treatment for Birdshot chorio-retinopathy and it can help with the prognostic outcome for different treatment regimes.

Novel findings in a case of late re-presentation of Quinine toxicity

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Eye Out-patient Department, Aberdeen Royal Infirmary

Aims: To present a case of delayed re-presentation of Quinine toxicity with electrophysiological abnormalities, some of which appear to be previously unreported in the literature

Methods: Case notes, imaging, OCT, and Electro-diagnostic testing of a recent case presenting to our team were reviewed. A literature search was performed using the OVID database

Results: A 49 year old man presented to Eye Out-Patient department, Aberdeen Royal Infirmary in June 2011 with increasing problems with dark adaptation and difficulties relating to a constricted visual field. It was noted that he had taken an intentional overdose of 8 grams of quinine 20 years earlier and had at that time had marked field defect that gradually recovered over a 2 year period following an ITU admission in 1992.
The patient refracted to 6/7.5 in each eye and had some concentric loss of peripheral visual field. Fundal examination revealed a degree of vascular attenuation. OCT showed marked thinning of the neuro-retinal layer, but apparently intact photoreceptors. In line with this his full field ERG showed reduced B-wave amplitude suggestive of inner retinal dysfunction. Of note pattern-ERG was absent, despite the patient refracting to 6/7.5 right and left. Multi-focal ERG was also undertaken and confirmed loss of central function peripheral retinal dysfunction at an inner retinal level

Conclusions: This case highlights an unusual late re-presentation of Quinine toxicity and in contrast to other previous case reports of those with early presentation, shows complete loss of pattern ERG, in addition to the previously documented peripheral electrophysiological abnormalities. Moreover it allows us to apply high resolution OCT to illustrate the structural changes in the retina that underpin the electrophysiological abnormalities, and clinical consequences of this severe ocular toxicity.

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Session Four

Chairs: Prof. Colin Barber & Dr Ruth Hamilton

Oral presentations

“Travelling Eyes”

Variability of the ERG across 15 UK clinics

R Hamilton[1], S Al Abdlseaed[2], J Healey[3], M Neveu[4], L Brown[3], D Keating[1], V McBain[5], D Sculfor[6], D A Thompson[7]

Department of Clinical Physics, NHS Greater Glasgow & Clyde, Glasgow[1]; Vision Sciences, Glasgow Caledonian University, Glasgow[2]; Clinical Engineering, Sheffield Teaching Hospitals NHS Foundation Trust[3]; Electrophysiology Department, Moorfields Eye Hospital, London[4]; Eye Department, Aberdeen Royal Infirmary, Aberdeen[5]; Eye Department, Stoke Mandeville Hospital, Aylesbury[6]; Clinical and Academic Department of Ophthalmology, Great Ormond Street Hospital for Children NHS Trust, London UK[7]

Purpose: Adequate reference data provide diagnostic thresholds with known certainty and are essential for clinical electroretinography. Improved standardisation of the ERG could facilitate widely applicable reference data, reducing the burden of reference data collection. As a first step towards UK-wide reference data, we aimed to quantify the extent of inter- (N=2) and intra-individual ERG variation across centres.

Methods: Fifteen UK electrophysiology centres and two subjects ("the Travelling Eyes") experienced in clinical electroretinography visited the centres between May 2011 and January 2012 and performed amplifier and photometric calibrations and ERGs according to Standard Operating Procedures. Stimuli were measured using an IL1700 photometer and amplifiers checked using custom-designed equipment. ERGs used local and 'ISCEV-exact' protocols. DTL and skin electrodes were used on both eyes. ISCEV dark-adapted (DA) 0.01, 3, 3 OPs and 10 ERGs, and light-adapted (LA) 3 and 3 30Hz flicker were recorded. Where possible (10/15 centres), data were anonymised and analysed by the same individual, masked to the centre and subject. Variability of each parameter was quantified using the coefficient of variation (CV: ratio of standard deviation: mean) expressed as a percentage, and as a range. Amplitudes were normalised using logarithms.

Results: ISCEV-exact and local protocol measures for DTL electrodes in left eyes are presented. Subject X consistently demonstrated smaller ERGs than subject Y. CVs ranged from 2-12% for subject X, and from 2-8% for subject Y for local protocols, and from 2-9% for both subjects using the ISCEV-exact protocol. Flash luminance variability only affected amplitude variability for the DA 0.1 b-wave (R2= 0.56 (p=0.005) and 0.59 (p=0.003) for subjects X & Y respectively). Correcting for flash luminance variability reduced amplitude CV from 6% and 5% to 4% and 3% for subjects X & Y respectively.

Conclusion: This study has established the feasibility of a multi-centre variability study. Remarkably low variability is evident across the 15 centres, even using non-standardised local protocol. Some amplitude variability is due to flash luminance variability. This unique insight into the reproducibility of ISCEV-standard ERGs enhances its reliability as an outcome measure. Future endeavours could widen application of the 'Travelling Eye' technique to improve quality assurance and endorse clinical collaboration across electrophysiology centres.

Acknowledgements: ISCEV small grants for laboratory visits; Department of Medical Physics & Clinical Engineering, Royal Liverpool University Hospital for donation of DTL electrodes; Mrs Mary Broadberry, Dr Paul Spry, Prof Daphne McCulloch, Dr Richard Hagan, Dr Neil Parry, Mr Chris Hogg, Mrs Karen Bradshaw, Mrs Beverley Holland, Dr Charles Cottrial, Dr Gillian Ruddock.

VARIABILITY OF THE FLASH AND BACKGROUND LUMINANCE ACROSS 15 UK CLINICS

A Al Abdlseaed[1], J Healey[2], M Neveu[3], D Keating[4], V McBain[5], D Sculfor[6], D Thompson[7], R Hamilton[4]

Vision Sciences, Glasgow Caledonian University, Glasgow[1]; Clinical Engineering, Sheffield Teaching Hospitals NHS Foundation Trust[2]; Electrophysiology Department, Moorfields Eye Hospital, London[3]; Department of Clinical Physics, NHS Greater Glasgow & Clyde, Glasgow[4]; Eye Department, Aberdeen Royal Infirmary, Aberdeen[5]; Eye Department, Stoke Mandeville Hospital, Aylesbury[6]; Clinical and Academic Department of Ophthalmology, Great Ormond Street Hospital for Children NHS Foundation Trust, London UK[7]

Purpose: In order to further the aim of UK-wide reference data, photometric calibrations were conducted whilst visiting 15 UK clinics to record ERGs as part of the 'Travelling Eyes' project. We aimed to quantify the variability of flash time-integrated luminances (flash brightness) and background luminances when employing both routine, local protocols, and imported, standardised 'ISCEV exact' protocols. Knowledge of flash variability was required to quantify its contribution to overall variability in the ERGs.

Methods: UK electrophysiology centres were recruited at the annual British Society for Clinical Electrophysiology of Vision (BriSCEV) conference, 2010. 15 centres participated in the study, and were visited between May 2011 and January 2012. Two experienced individuals were trained to perform standardised photometric calibrations using the same, calibrated (traceable to National Standards Laboratory) IL1700 photometer. At the beginning of each visit, the photometer was switched on for at least one hour prior to any measurements. Routine, local ERG stimuli brightness were captured using either time-integrating mode (flashes) or steady-state mode (backgrounds). Repeated measures were used as appropriate. The procedure was repeated for the ISCEV-exact protocols. Values were log-transformed to create parametric data, and results compared across the 15 centres.

Results: Photometric data are currently available for 14 centres. For local protocols, centres achieved flash luminances within a median of 0.01 log units of target dark-adapted 0.01 stimuli (range -0.11–0.36); within a median of 0.01 log units of target dark-adapted (or light-adapted) 3 stimuli (range -0.02–0.11); within a median of 0.01 log units of target dark-adapted bright (10 or 30) stimuli (range -0.03–0.11); and within a median of 0.01 log units of target light-adapted 30 background stimuli (range -0. 1–1.48).

For ISCEV exact protocols, with targets being those of the current ISCEV ERG standard, centres achieved flash luminances within a median of 0.02 log units of target dark-adapted 0.01 stimuli (range -0.2–0.3); within a median of 0.002 log units of target dark-adapted (or light-adapted) 3 stimuli (range -0.1–0.09); within a median of 0.07 log units of target dark-adapted 10 stimuli (range -0.13–0.14); and within a median of 0.01 log units of target light-adapted 30 background stimuli (range -0.05–0.12).

Proportion of centres conforming to the ISCEV tolerance of ±10% was 4/14 for dark-adapted 0.01 flashes (median (range)) 0.010 (0.004-0.101) cd s m-2 ; and 8/13 for all other protocols, dark- or light-adapted 3 flashes 2.84 (2.23-3.15) cd s m-2, dark-adapted 10 flashes 9.97 (8.06-17.53) cd s m-2 , and 30 background luminances 29.4 (19.7-46.5) cd s m-2.

Actual 'ISCEV exact' stimuli luminances were (median (range)) 0.01 (0.005–0.016) cd s m-2 for dark-adapted 0.01 stimuli (7/13 within ISCEV tolerance); 3.02 (2.42–3.78) cd s m-2 for dark or light-adapted 3 stimuli (6/13 centres within ISCEV tolerance); 8.6 (7.3–13.5) cd s m-2 for dark-adapted 10 stimuli (2/13 centres within ISCEV tolerance); and 29.4 (22.7–33.9) cd m-2 for light-adapted 30 background stimuli (10/13 centres within ISCEV tolerance).

Conclusion: UK clinics achieve, on average, a very close match to target stimuli used in routine, local ERG protocols. Two centres demonstrated outlying data at the ISCEV DA 0.01, one centre used very dim 0.001 and the other slightly brighter 0.1. On attempting to standardise luminances still further by importing a standard protocol, the number of centres generating stimuli which fell within ISCEV tolerance fell at the ISCEV 3 and 10 probably due to the use of xenon flashes rather than LED flashes, but it raised at the dim flash and background, probably due to the use of xenon flashes rather than LED flashes.

Acknowledgements: ISCEV small grants for laboratory visits; Department of Medical Physics & Clinical Engineering, Royal Liverpool University Hospital for donation of DTL electrodes; Mrs Mary Broadberry, Dr Paul Spry, Prof Daphne McCulloch, Dr Richard Hagan, Dr Neil Parry, Mr Chris Hogg, Mrs Karen Bradshaw, Mrs Beverley Holland, Dr Charles Cottrial, Dr Gillian Ruddock.

Variability of amplifier characteristics across 15 UK clinics

Healey J[1], Al Abdlseaed A[2], Neveu M[3], Brown L[1], Keating D[4], McBain V[5], Sculfor D[6], Thompson DA[7], Smith D[8], Hamilton R[9].

Clinical Engineering, Sheffield Teaching Hospitals NHS Foundation Trust1, Vision Sciences, Glasgow Caledonian University, Glasgow2, Electrophysiology Department, Moorfields Eye Hospital, London3, Department of Ophthalmology, Gartnavel General Hospital, Glasgow, U4, Eye Department, Aberdeen Royal Infirmary, Aberdeen5, Eye Department, Stoke Mandeville Hospital, Aylesbury6, Clinical and Academic Department of Ophthalmology, Great Ormond Street Hospital for Children NHS Foundation Trust, London7, Electronics Section of NHS Greater Glasgow & Clyde's Department of Clinical Physics and Bioengineering8, Department of Clinical Physics, NHS Greater Glasgow & Clyde, Glasgow9.

Purpose: As a first step towards UK-wide reference data for clinical electroretinography, the UK 'Travelling Eyes' project recorded ERGs from the same two individuals at 15 clinics across the UK. Part of the protocol included an amplifier check. The aim of this study is to report the variability of amplifier responses across 15 centres to a standard input square pulse.
Methods: 15 UK electrophysiology centres participated in the study and were visited by the Travelling Eyes between May 2011 and January 2012. An amplifier checking device was designed and manufactured by the Electronics Section of NHS Greater Glasgow & Clyde's Department of Clinical Physics and Bioengineering (DS). The device was connected to the patient headbox and was triggered by the system's acquisition optical flash. The device produced a nominal 50 µV, 10 ms square pulse 40 ms after triggering. Averaging was used to improve measurement accuracy in the presence of random electrical noise. The time of onset and the amplitude of the pulse were measured for each centre. The calibration of the amplifier checking device was determined against traceable standards.
Results:Data is currently available for 14 of the 15 centres as analysis is on-going. A range of equipment was used in the 14 centres with the majority using the Espion visual electrophysiology system (Diagnosys, UK). Pulse onset as displayed by the systems ranged from 49.9 ms to 51.6 ms (mean 50.8 ms). Pulse height ranged from 48.9 µV to 53.7 µV (mean 51.6 µV).
Conclusions: Robust conclusions must await the completion of analysis, which is ongoing. The preliminary results shown here suggest, that in terms of measuring ERG timings there is little variation between local systems; however there does appear to be a more substantial variation in the amplitude measurements with errors from -16 % to -3 %. Variance in the calibration between centres must be combined with any normal range shared between centres, and hence will reduce the sensitivity and specificity of any tests conducted using shared normal ranges and local equipment with its inherent calibration variability.

ACKNOWLEDGEMENT: ISCEV small grants for laboratory visits;
Department of Medical Physics & Clinical Engineering, Royal Liverpool Hospital for donation of DTL electrodes; Mrs Mary Broadberry, Dr Paul Spry, Prof Daphne McCulloch, Dr Richard Hagan, Dr Neil Parry, Mr Chris Hogg, Mrs Karen Bradshaw, Mrs Beverley Holland, Dr Charles Cotriall, Dr Gillian Ruddock.

Variability of the ERG recorded with skin and DTL electrodes across 15 UK clinics

M Neveu[1], A Al Abdlseaed[2], J Healey[3], D Keating[4], V McBain[5], D Sculfor[6], D Thompson[7] R Hamilton[4]

Electrophysiology Department, Moorfields Eye Hospital, London[1], Vision Sciences, Glasgow Caledonian University, Glasgow[2], Clinical Engineering, Sheffield Teaching Hospitals NHS Foundation Trust[3], Department of Clinical Physics, NHS Greater Glasgow & Clyde, Glasgow[4], Eye Department, Aberdeen Royal Infirmary, Aberdeen[5], Eye Department, Stoke Mandeville Hospital, Aylesbury[6], Clinical and Academic Department of Ophthalmology, Great Ormond Street Hospital for Children NHS Foundation Trust, London UK[7]

Purpose: To assess and quantify the extent to which inter- and intra-individual electrophysiology parameters and measures differ across the UK, and from the ISCEV standards. The collection of such data enables improved standardization, can contribute to widely applicable reference data and facilitate the use of the ERG in determining the safety and efficacy of therapeutic interventions in multi-centre trials.

Methods: Two subjects (the 'travelling eyes', subjects X and Y) were recruited to the 'Travelling Eyes' project at the annual BriSCEV conference, 2010. The travelling eyes visited 15 UK electrophysiology centres between May 2011 and January 2012. At each centre ERGs were recorded according to the local protocol and an 'ISCEV-exact' protocol. The ISCEV-exact protocol included DA (dark adapted) 0.01, DA 3, DA 3 Ops, DA 10, LA (light adapted) 3 and LA 3 30Hz. To incorporate the electrodes most widely used across the participating centres, ERGs were recorded using a DTL fibre electrode and a disposable skin electrode, applied to each eye of each subject. The amplitude and peak time of all ERGs were measured by the same individual, masked to the centre and the subject. The variability between DTL and Skin electrodes, exact and local protocols and between subjects was assessed using the coefficient of variation (CV) expressed as a percentage and as range.

Results: Overall, ERGs recorded with DTL fibre electrodes were approximately 50% larger in amplitude compared with amplitudes obtained with disposable skin electrodes. Across all centres the coefficient of variation (CV) in ERG measures was consistently lower for DTL than skin electrodes, to local and exact protocols and in both subjects. The ISCEV exact protocol using DTL electrodes elicited the least variability (Subject X, DTL CV = 12%, Skin CV=18%; Subject Y, DTL CV=14%, skin CV=22%). Across all centres the least variability was demonstrated in the a-wave amplitudes of DA 3, DA 10 and LA 3 (CV=10% for all); peak times measures of LA 3 30Hz (CV=2%).

Conclusion: The Travelling Eyes project provides a direct comparison of use of the DTL and skin electrode from 15 UK electrophysiology centres. The use of the DTL electrode for recording of the ERG (using both local and ISCEV-exact protocols) provides more stable and consistent measures of amplitude and peak time compared with the skin electrode. Similar to previously published studies comparing electrode types, ERG amplitudes are approximately 50% lower for skin electrodes compared with DTL electrodes.

Acknowledgements: ISCEV small grants for laboratory visits; Department of Medical Physics & Clinical Engineering, Royal Liverpool University Hospital for donation of DTL electrodes; Mrs Mary Broadberry, Dr Paul Spry, Prof Daphne McCulloch, Dr Richard Hagan, Dr Neil Parry, Dr Dorothy Thompson, Mr Chris Hogg, Mrs Karen Bradshaw, Mrs Beverley Holland, Dr Charles Cottrial, Dr Gillian Ruddock.

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Session Five

Chairs: Drs Lawrence Brown & Magella Neveu

Oral presentations

"Physics & physiology"

Quantification of ERG stimuli

Chris Hogg, Lauren Perkins, Harpreet Shinhmar.

Moorfields Eye Hospital, London.

Purpose: Following the upgrade of a ganzfeld stimulator, normative ERG data was collected to compare both the new and old stimulus. This showed a systematic difference between the two sets of LED light sources. The reasons for this difference were investigated.

Methods: Two healthy young subjects were tested on an example of both the original and the upgraded ganzfeld. Each subject was tested on both in the same session, and the order was reversed between subjects.
Photometric, radiometric and spectrographic data was subsequently obtained for both systems, along with calibrations of the data acquisition system.

Results: Both subjects produced similar differences in the ERG responses between stimulators that could not be explained photometrically. An examination of the spectral composition of the stimuli indicates a likely explanation for the differences in the ERGs.

Conclusion: Whilst the differences in ERG results are relatively small, these are from healthy young subjects, and there is every likelihood that the differences would be exacerbated in older subjects. These differences may have significant effects in some retinal diseases.
The need for both site specific normative data and the detailed calibration of stimuli demonstrated.

PHYSIOLOGICAL CORRELATES OF PERCEPTUAL LEARNING

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Purpose: To compare haemodynamic and electrophysiological responses in amblyopic and normally sighted participants whilst they did a perceptual learning task

Methods: Functional near infrared spectroscopy (fNIRS) and electroencephalography (EEG) (Wijeakumar et al 2012; Wijeakumar et al 2012) were used to record the extent of change in activation patterns in normal and amblyopic cortices while the observers were trained in a dichoptically presented game of tetris. fNIRS measured concentrations of oxyhaemoglobin (HbO), deoxyhaemoglobin (Hb) and total haemoglobin (THC) on a 2 channel oximeter (Oxiplex TS). EEGs were recorded on a multichannel Brain Vision EEG acquisition system.

Pre-training: Global motion thresholds were measured using a 2-Alternative Forced Choice (2-AFC) discrimination task in normal and amblyopic participants while viewing random dot kinematograms. The stimuli were viewed via eMagin Z800 3DVisor goggles, which allowed the manipulation of individual input to either eye. Visual feedback was given in the form of the fixation dot changing in colour to reinforce correct responses. Binocular motion coherence thresholds were measured for each participant. The mean threshold number of dots was then used in a second program where the signal dots for motion coherence set at a high contrast were presented to the AE with noise dots increasing in contrast from 0% presented to the FE (randomly assigned in the visually normal participants). Varying the contrast of the signal and noise independently makes it possible to present stimuli with high contrast to the AE and low contrast to the FE allowing the extent of binocular interaction present to be measured. This technique of matching visibility 'balance point' between eyes allows for maximum binocular combination of the visual stimuli and is described by Knox et al (2012)

Training: A dichoptic perceptual training task of the game tetris that involved the manipulation of the position and orientation of falling 4-block shapes was undertaken for 5 days (3 x 15 minute sessions/day). The aim of the game was to form a complete wall of blocks with no gaps. This game was modified so that the falling blocks were presented to the AE, and the blocks that form the wall were presented to the FE via the HMD goggles. Inter-ocular contrast thresholds measured previously were then used to match the visibility of the blocks in each eye by reducing the contrast of the blocks presented to the FE while the blocks presented to the AE were maintained at 70% contrast. This stimulus arrangement required binocular interaction to complete the task.

Physiological Recordings: fNIRS and electrophysiological recordings were taken from normal and amblyopic observers from over the primary visual cortex (V1) on Day 1, Day 3 and Day 5 of the training.

Clinical assessments and behavioural data (task-based scores – levels reached) were also collected.

Results: VA and stereo acuity measures were taken both pre and post training. These showed improvements post training in amblyopic observers. Normal participants also showed an increase in performance at the task.

fNIRS: Pre-training: All three haemoglobin chromophores were recorded and normalized to a pre-stimulus baseline. Changes in HbO levels in response to the tetris stimulus on Day 1 were smaller in amblyopes than in normal participants.

Post training: HbO levels increased as a result of training, being greatest on Day 3 of the training period. Normal participants showed a steady increase in HbO until Day 5 of the training period.

Electrencephalography: FFTs were performed on EEG records from O1, Oz and O2 from amblyopic and normal participants. Pre-training: No difference was seen between amblyopic and normal participants on Day 1 between amblyopic and normal participants in the gamma band response (GBR). Post Training: Increased GBRs was observed from Day 1 to Day 5 over all examined areas and observers.

A linear correlation was observed between behavioral, electrophysiological and fNIRS measures over V1.

Conclusion: Our results, which included behavioral, clinical and physiological measures, have shown that visual perception 'improves' as a consequence of perceptual learning.

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WHEN IS AN ONSET NOT AN ONSET? AN ERG RIDDLE

Neil Parry[1,2]; Declan McKeefry[3]; Jan Kremers[3, 4]; Ian Murray[2]; Naveen Challa[3] & Gobinder Pangeni[4]

1. Manchester Royal Eye Hospital, UK 2. University of Manchester, UK 3. University of Bradford, UK 4. University of Erlangen-Nuernberg, Germany

Purpose: To describe the L- and M-cone isolating long duration ERG. The conventional view of the long-duration flash ERG is that it comprises an a/b wave complex at onset, and a d-wave at offset, the b and d waves largely reflecting the activity of on- and off-bipolars. We have recently been exploring the individual cone contributions to these responses, using cone isolating stimuli generated on a 4-colour LED ganzfeld stimulator (Espion ColorDome).

Methods: The isolation of an individual cone mechanism is achieved by silent substitution, which uses the spectral radiance of the LEDs and the spectral sensitivity of the 4 photoreceptor classes to calculate pairs of stimuli in which the responses of the rods and two of the cones are equalised. Thus they do not respond when the stimulus changes, the only response coming from the unsilenced photoreceptor. This limits the Weber contrast of any single LED (and thus of the whole stimulus) to 1.0. In fact, the maximum cone contrast we are able to achieve with all 4 photoreceptor classes was 0.11 (limited by the M-cones). Since the conventional luminance long-duration ERG is recorded with Weber contrast of about 3, we first established that, with a contrast of 0.11, we can still record the 'classical' a/b/d ERG.

Results: Here we describe the results of our studies on long (L) and medium (M) wavelength sensitive cones. In most subjects, L-isolating stimulation produces the conventional a/b response at onset and a d-wave at offset. Paradoxically, the M onset response is usually a simple positivity, whilst the offset produces a negative/positive wave. To all intents and purposes it appears that M stimulation can produce an onset d-wave and an offset a/b wave.

Conclusions: The retina is usually L-cone dominated, and bipolars are able to signal cone opponency. One possible explanation , then, is that is that we are measuring the opponent activity (L-off) from the L bipolars when the M cones are switched on. Whatever the reason for this phenomenon, it seems to explain some paradoxical phase behaviour we have observed in the steady-state ERG. The individual photoreceptor responses show a high degree of linear additivity, and it is therefore possible that this phenomenon may produce phase cancellation in the luminance ERG and go some way to explaining the variability of the standard clinical ERG.

Timing of the a-wave as a measure of rod sensitivity

John Robson and Laura Frishman
University of Houston College of Optometry

Introduction: Contrary to common belief, the major part of the contribution to the full-field dark-adapted ERG of the rod photocurrent is provided not by the current flowing from rod outer to inner segments but by the current flowing from inner segments into the rod axons in the outer nuclear layer (ONL) of the retina. This was observed many years ago in excised rat eyes by Penn and Hagins (1969) and Arden (1976) and is explained by the much higher resistivity of the interstitial space in the ONL compared with that in the interstitial space surrounding the rod outer and inner segments (the sub-retinal space). Arden also noted that the component of the ERG recorded from the ONL had an initial nose that was absent from the component from the sub-retinal space.

Results: By simulating the trans-retinal voltage generated by the extracellular flow of rod photocurrent in the electrical circuits of the retina (using a model based on the electrical measurements of Hagins et al., 1970), we have recently found that this nose can be explained as resulting from capacitive currents that flow into the membrane of the rod axon when the stimulus is strong enough to provide a rapidly changing photocurrent. The time to peak of the nose in our simulations is directly dependent on the energy of the stimulus as well as on the basic sensitivity of the rods. For ERGs of mice and humans, taken from several published studies, we found that the way in which the timing of normal a-waves depends upon flash strength corresponds closely with the way in which the timing of the nose in our trans-retinal voltage simulations depends upon stimulus energy.

Conclusion: On the basis of this correspondence we support the suggestion by Hood and Birch (2006) that it should be possible to estimate the basic sensitivity of rods by a simple determination of the rise time of the ERG a-wave evoked by a single high energy flash.

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Eds. Heckenlively and Arden, Ch35:487-501 Penn RD. and Hagins WA. (1969) Nature 223:201-205.

Notes

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Registrants

Abdelkader	Ehab	Aberdeen Royal Infirmary
Abdlsaed	Abdlsaed	Glasgow Caledonian University
Adams	Theresa	Stat One, West Midlands
Albright	Stuart	Stat One, West Midlands
Barber	Colin	Queen's Medical Centre, Nottingham
Binns	Alison	Cardiff University
Bollemeijer	Jan Geert	LUMC, Hospital , Netherlands
Brown	Lawrence	Sheffield Teaching Hospitals
Browning	Andrew	Royal Victoria Infirmary, Newcastle
Calcagni	Antonio	Aston University
Carter	Andrew	Moorfields Eye Hospital, London
Chin	Kong	Leicester Royal Infirmary
Chua	Paul	Aberdeen Royal Infirmary
Cornish	Kurt	Aberdeen Royal Infirmary
Cottrial	Charles	Oxford Eye Hospital
Gemmel	Elaine	Kelvin Vision, Glasgow
Delaney	Claire	Manchester Royal Eye Hospital
Goude	Katherine	Sheffield Teaching Hospitals
Greiner	Kathrin	Aberdeen Royal Infirmary
Hamilton	Ruth	Royal Hospital for Sick Children, Glasgow
Healey	Jamie	Sheffield Teaching Hospitals
Hermens	Hans	UMC St Radboud, Netherlands
Hoeks	Liesbeth	UMC St Radboud, Netherlands
Hogg	Chris	Moorfields Eye Hospital, London
Jowett	Anne	Nottingham University Hospitals
Keating	David	Southern General Hospital, Glasgow
Kelly	Susanne	Stoke Mandeville Hospital
Lois	Noemi	University of Aberdeen
Mai	Matthias	Roland-consult, Germany
McBain	Vikki	Aberdeen Royal Infirmary
McCulloch	Daphne	Glasgow Caledonian University
Maguire	John	Manchester University
McQuiston	Ann	Tenent Institute, Glasgow
Mohammed	Bashar	Aberdeen Royal Infirmary
Mollinger	Cora	LUMC, Hospital , Netherlands
Murphy	Rachel	Moorfields Eye Hospital, London
Neveu	Magella	Moorfields Eye Hospital, London
Osei-Lah	Abena	Poole Hospital NHS Foundation Trust
Parks	Stuart	Gartnavel General Hospital, Glasgow
Parry	Neil	Manchester Royal Eye Hospital
Paterson	Craig	Gartnavel General Hospital, Glasgow
Reddy	Aravind	Aberdeen Royal Infirmary

Robson	Anthony	Moorfields Eye Hospital, London
Robson	John	University of Houston
Robson	Richard	Diagnosys, Cambridge
Sculfor	David	Stoke Mandeville Hospital
Shahani	Uma	Glasgow Caledonian University
Shankar	Vikas	Aberdeen Royal Infirmary
Smith	Richard	Buckinghamshire Healthcare NHS Trust
Staunton	Edward	Kelvin Vision, Glasgow
Thompson	Dorothy	Great Ormond Street Hospital for Children
Timms	Nick	Heidelberg Engineering, Hemel Hempstead
Tyagi	Pallavi	Aberdeen Royal Infirmary
Wallace	Sharon	Nottingham University Hospitals NHS Trust
Wen	Yaquin	Nottingham University Hospital NHS Trust
Whittle	Jonathan	Princess Alexandra Eye Pavilion, Edinburgh

Correct as of 03/09/3012

Local helpers

Evelyn McBain
Dave McBain
Karon McEwing
Claire Melvin
Rhiann O'Malley
Laura Hannah

PROGRAMME OVERVIEW

Monday 10th September

$9^{15} – 10^{45}$	BriSCEV Course part 1
$10^{45} – 11^{15}$	Coffee break
$11^{15} – 12^{00}$	BriSCEV Course part 2
$12^{00} – 12^{45}$	Lunch and commercial exhibition
$13^{00} – 13^{45}$	Welcome and Guest lecture: Miss Noemi Lois
$13^{45} – 15^{00}$	Oral presentations “Retina – structure & function”
$15^{00} – 15^{15}$	Coffee break & commercial exhibition
$15^{15} – 15^{45}$	Commercial presentations
$15^{45} – 16^{30}$	Guest lecture: Dr Zofia Miedzybrodzka
$16^{30} – 17^{30}$	BriSCEV business meeting
$17^{30} – 18^{00}$	Coach transfers from hotels & Med Chi to Curl Aberdeen
$18^{00} – 19^{00}$	Welcome, soup and safety brief at Curl Aberdeen
$19^{00} – 20^{30}$	Curling Bonspiel
$20^{30} – 23^{00}$	Dinner at Curl Aberdeen

Tuesday 11th September

$9^{00} – 10^{00}$	Clinical case session
$10^{00} – 10^{45}$	Guest lecture: Professor David Lurie
$10^{45} – 11^{45}$	Poster parade, coffee break & commercial exhibition
$11^{45} – 12^{45}$	Oral presentations “Travelling eyes”
$12^{45} – 14^{00}$	Lunch and commercial exhibition
$14^{00} – 15^{00}$	Oral presentations “Physics & physiology”
$15^{00} – 15^{30}$	Prize giving and farewell tipple
15^{30}	Conference ends