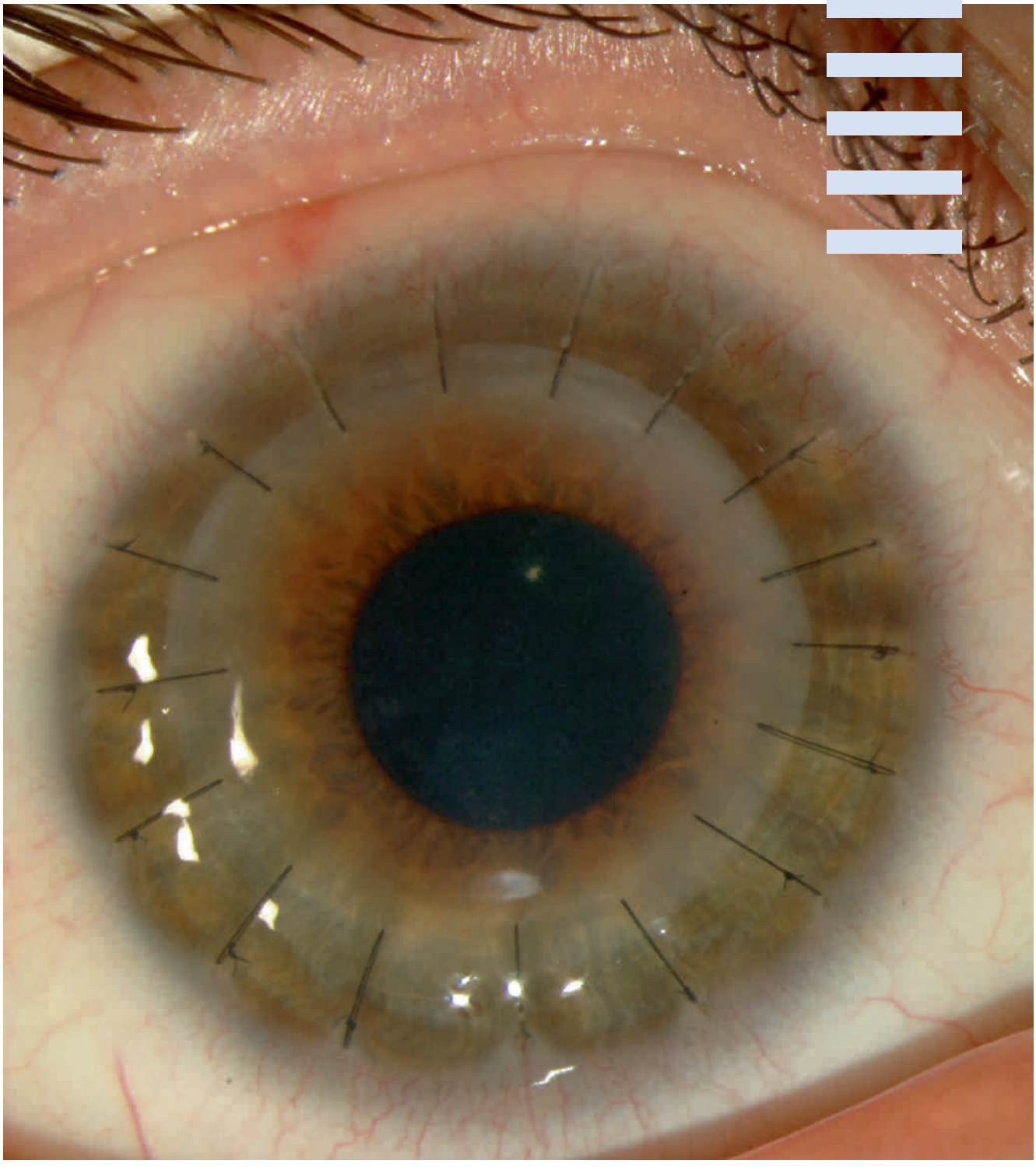
Supplement to
AUSTRALIAN OPTOMETRY

pharma

JUNE 2013



- LANDMark Study results
- POHS treatment with bevacizumab
- Anti-VEGF for AMD
- Allergies
- Selective laser trabeculoplasty
- Other uses of OCT technology
- Antibacterial honey for ocular surface disease
- Corneal transplants

NOW PBS LISTED

20/200 O

20/100 N E

20/70 INJECTION

20/50 EVERY TWO

20/40 M O N T H S*

20/30 *EYLEA® TREATMENT IS INITIATED

20/25 WITH ONE INJECTION PER MONTH FOR THREE CONSECUTIVE MONTHS, FOLLOWED BY ONE

20/20 INJECTION EVERY TWO MONTHS[1]

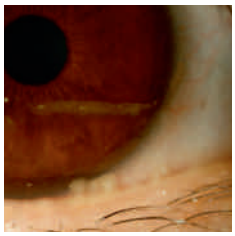
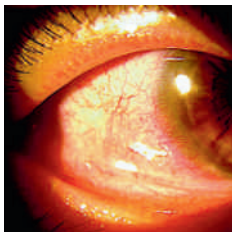
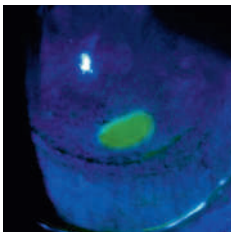
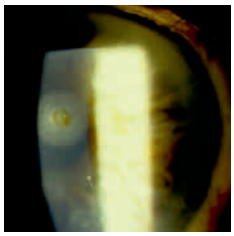
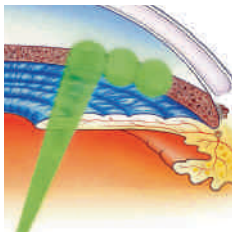
PBS Information: Authority Required for the treatment of subfoveal choroidal neovascularisation (CNV) due to age-related macular degeneration (AMD). Refer to PBS Schedule for full Authority Information.

PLEASE REVIEW APPROVED PRODUCT INFORMATION BEFORE PRESCRIBING. APPROVED PRODUCT INFORMATION AVAILABLE ON REQUEST. FOR THE MOST UP TO DATE PRODUCT INFORMATION go to http://www.bayerresources.com.au/resources/uploads/PI/file10294.pdf.

MINIMUM PRODUCT INFORMATION EYLEA [aflibercept (rch)] INDICATIONS: EYLEA (aflibercept) is indicated for the treatment of neovascular (wet) age-related macular degeneration (wet AMD). **DOSAGE AND ADMINISTRATION:** Injection volume of 50 µL EYLEA (equivalent to 2 mg aflibercept). Treatment is initiated with one intravitreal injection per month for three consecutive months, followed by one injection every two months. **CONTRAINDICATIONS:** Known hypersensitivity to aflibercept or excipients; ocular or periocular infection; active severe intraocular inflammation. **PRECAUTIONS:** Endophthalmitis, increase in intraocular pressure; see full PI for effects on fertility, pregnancy, lactation, effects on ability to drive or use machines. **ADVERSE EFFECTS:** Cataract, conjunctival haemorrhage, eye pain, retinal detachment, retinal pigment epithelium tear, detachment of retinal pigment epithelium, corneal erosion, intraocular pressure increased, vision blurred, vitreous floaters, corneal oedema, vitreous detachment, injection site pain, foreign body sensation in eyes, lacrimation increased, eyelid oedema, injection site haemorrhage, conjunctival hyperaemia. Others: see full Product Information. Date of most recent amendment: December 2012.
References: 1. EYLEA Product Information.

EYLEA®
aflibercept (rch)
solution for intravitreal injection

AUSTRALIAN OPTOMETRY
pharma
JUNE 2013

Published by
OPTOMETRISTS
ASSOCIATION AUSTRALIA

Editor: **JEFF MEGAHAN**

National Publications Manager:
SANDRA SHAW
Journalist: **JENNY KELLETT**
Advertising: **SANDRA SHAW**
Clinical Editor:
Associate Professor **MARK ROTH**
Department of Optometry
and Vision Sciences,
The University of Melbourne

Optometrists Association Australia
ABN 17 004 622 431
204 Drummond Street
Carlton VIC 3053
Tel (03) 9668 8500
Fax (03) 9663 7478
j.megahan@optometrists.asn.au
www.optometrists.asn.au

COVER: Corneal graft
Photo: Royal Victorian Eye and Ear Hospital

Pharma is distributed in Australia and New Zealand. All references to pharmaceutical preparations in *Pharma* are applicable within Australia.

Congratulations!

Guest editorial

Dr J James Thimons OD
Clinical Professor, Pennsylvania College of Optometry and New England College of Optometry
Affiliate Professor, Inter American University of Puerto Rico

The authority to treat glaucoma will have a positive impact on practice growth, the perception of patients and the development of the optometric profession in Australia.

To the practising optometrists of Australia, I offer my enthusiastic 'thumbs up' in response to the OBA's recent decision granting therapeutically-endorsed optometrists the right to independently prescribe topical anti-glaucoma medicines.

To achieve this success, almost two decades of dedication and persistence were necessary. In the end, it was the commitment of those many members of the optometry profession that brought this to fruition.

I was fortunate enough to have shared in some of the steps along the way and am delighted to see that the journey has ended with a victory.

Sometimes legislation or protocol changes require such a long time to be realised that it calls into question the cost of the investment. To those who may think that the length of your efforts to achieve this goal were too great relative to the return, I offer my view on what this privilege has meant to the optometrists in the USA. I hope it provides some perspective for what can be accomplished in Australia.

Fundamental change

About 25 years ago, optometrists began in earnest the march to treat glaucoma in the USA. That commitment, which in part stemmed out of the now-famous LaGuardia meeting,[1] provided the impetus for a nationwide change that would forever alter the destiny of the individuals in the profession and the perception of the public in regards to optometry.

While being able to treat conjunctivitis, inflammation and ocular surface disease was important, the ability to diagnose and treat glaucoma caused a seismic shift in the way our patients and the public gauged the importance of our profession.

Simply stated, the authority to independently treat glaucoma has been integral to optometry's rise as a profession in the United States.

Treating glaucoma has allowed the primary eye-care clinician to be defined as a full-scope provider, which has materially changed the landscape of optometry's role in eye care at every level. This has translated directly into a change in perception of both patients and other providers, and has created remarkable growth for the profession as part of the overall health-care system.

One of the most significant changes I have observed related to glaucoma management is in practice growth and development. Before the authority to treat glaucoma was achieved, it was typically the case that a patient would be diagnosed as a glaucoma suspect or glaucoma patient and then referred to a local ophthalmologist who would see the patient and attach them to their practice permanently.

This loss of patient base had an effect on our practices for two reasons. The first and most obvious reason was, of course, the numerical loss of patients. The second and less visible reason was the underlying message that was being given to the patient, their family and friends: when a serious problem is present, optometry is not the profession to address it. We watched for years as this erosion of our patients' confidence in our profession occurred, all the while trying to convince ourselves that it did not have a large impact.

I can assure you that the opposite is true. For the past 15 years, I have been able to independently care for my glaucoma patients.

The ability to provide ophthalmic services equally with our colleagues in ophthalmology in this area has created a sense of trust in my patients that is not seen in any other type of care I provide.

Patients inherently understand the importance of this disease and assign a level of professional expertise to clinicians who treat it. The independent management of glaucoma has been the single most important source of growth in my office over the past decade

Opportunities for growth

The authority to treat glaucoma has had an impact on practice growth, on the perception of our patients and on the overall development of our profession. Working independently in glaucoma has permanently altered US optometry in the remarkable changes it brings to the clinician and their practices.

The technology associated with glaucoma is exciting and constantly evolving. It is an ever-expanding menu of responsibilities that, if accepted, make us better health care professionals with every working day.

Finally, I have observed that optometry is ideally suited to face this disease. A profession with our level of education in the neurosciences, pharmacology, biology, anatomy and psychology is perfectly developed to deal with a condition like glaucoma. I have watched my colleagues develop over the years into outstanding clinicians who are prepared for the responsibilities and provide a level of care that is second to none.

It is sometimes hard to recall when glaucoma treatment was not of part of our profession, but it is easy to remember what the professional landscape was like before it became part of optometry. The ability to treat glaucoma more than any other aspect of optometry's growth in the past 20 years has created an indelible change that has impacted every aspect of the profession. The journey has been a challenge but the rewards have been beyond all expectations.

It is so gratifying to see colleagues across the world move further into the glaucoma arena to service the growing demands of the health system. Congratulations on a great achievement. I wish you the benefits that it has brought to the optometry patients in the United States and the increased success to the profession of optometry. I look forward to seeing the new Australian optometry in the future. ■

1. The LaGuardia Meeting took place on January 16 1968, in a hotel room at the LaGuardia airport in New York City. The meeting involved about two dozen participants, most of whom were then connected to schools and colleges of optometry.

Recurrent corneal erosion

Diagnosis and management

Dirk den Dulk
BOptom GradCertOcular-Therap

Case report

Recurrent corneal erosion (RCE) is most often associated with superficial or micro trauma to the cornea. Common causes are paper cuts, foreign bodies, chemical burns, exposure or contact lens wear. There are other possible causes, such as epithelial basement membrane dystrophy (EBMD).

The result of RCE is the disruption to the adhesive properties between epithelial cells and Bowman's membrane. In the case of trauma, erosion usually occurs shortly after the insult but with EBMD, erosion can be devastatingly spontaneous.

A 41-year-old female presented with right anterior ocular pain, photophobia and tearing. Importantly, the level of pain experienced was severe. This patient entered with hands pressed over the side of her head, in obvious discomfort and desperate for pain relief.

She had experienced similar episodes six months previously, without the same magnitude of intensity. A diagnosis of dry eye syndrome had been given with a treatment of ocular lubricants.

General and ocular health were unremarkable, apart from dry eyes and regular optometric attendance for myopic refraction. There had been no previous ocular trauma. She reported contact lens wear but not for many years.

Ocular examination

Due to the high level of ocular pain and photophobia, examination was almost impossible without anaesthesia, which was instilled to expedite this process. Corrected VAs were RE 6/7.5 and LE 6/6. Pupil size and reaction were normal. Slitlamp examination of the right eye revealed an inferior corneal lesion, circular, with small areas of opaque, whitish dots (micro cysts)–typical Map-dot-fingerprint dystrophy. There was mild anterior hyperaemia and no anterior chamber reaction. Examination of the left eye revealed asymmetric mild basement membrane changes.

The diagnosis was corneal epithelial basement membrane dystrophy with right corneal erosion.

Treatment and management

In this acute phase, treatment included prophylactic antibiotics, Ocuflox RE four times a day, with topical anti-inflammatory application, FML RE four times a day. Unpreserved ocular lubricant (Systane) was added twice-hourly for sustained lubrication of the right eye, with Genteal gel at bedtime.

The following morning, the patient was waiting at the front door for my arrival. She reported a sleepless night with a high level of pain. Treatment was not altered apart from the insertion of a silicone hydrogel contact lens. Almost immediate pain relief was achieved.

Review on the following day revealed improvement in comfort and pain. Within two days, re-epithelialisation was evident and the bandage contact lens was removed. After five days, antibiotic drops were discontinued and FML drops were tapered, with continued bilateral management using ocular lubricating drops by day and lubricating gel before sleep. Additionally, patient education, with regard to environmental factors (for example, air conditioning and heating) and care on waking, was given. FML drops were tapered.

If conservative management is unsuccessful, with recurring episodes, other management options could include:

- Debridment of affected corneal surface to allow regeneration of healthy epithelial cells
- Anterior corneal needling or puncture, which enhances adhesion of epithelial cells
- A combination or oral doxycycline and topical steroids as a combination to counter corneal presence of matrix metalloproteinase
- Corneal surface ablation with excimer laser to remove surface irregularities.

Conclusion

For the patient, RCE can cause severe pain. The acute phase has been likened to a bad tooth ache. The patient in this case study reported it to be 'worse than child birth'. The up-side is that with careful management and patient education, these episodes can be controlled and symptoms minimised. ■

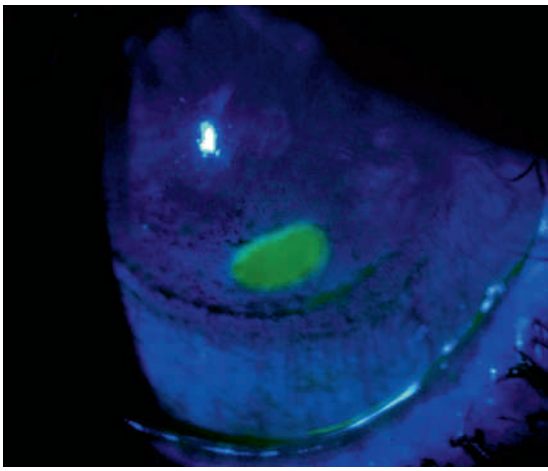


Figure 1. Corneal erosion lesion due to epithelial basement membrane dystrophy

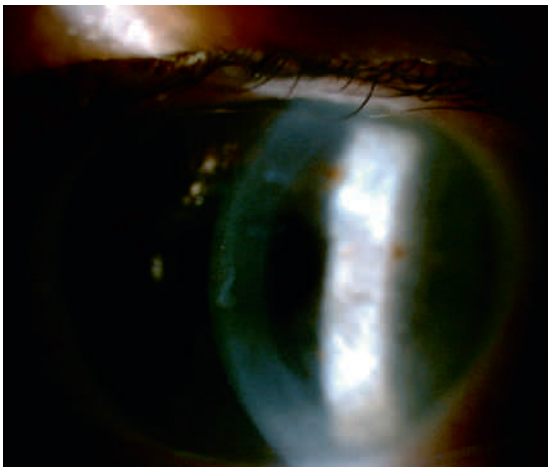


Figure 2. Cornea post-treatment after re-epithelialisation

LANDMark Study

Longitudinal assessment of

Dr Katie Edwards PhD
Postdoctoral Research Fellow, Faculty of Health, School of Optometry and Vision Science, QUT

Dr Nicola Pritchard PhD
Research Associate, Faculty of Health, School of Optometry and Vision Science, QUT

Professor Nathan Efron PhD DSc
Research Professor, Institute of Health and Biomedical Innovation and School of Optometry and Vision Science, QUT

When evaluating diabetic retinopathy, optometrists may consider using measures of visual function such as visual acuity but it is the structural measures, such as direct examination of the retinal fundus, that allow monitoring of even the smallest deterioration or improvement in retinopathy.

Examination of the retina in fine detail is essential to monitor a disease progression and forms the basis of decisions on management plans such as commencement of either tighter blood glucose control or laser or medical treatment. The ability to monitor small changes in retinopathy status has also allowed surgical and therapeutic treatments to be properly evaluated in trials and brought to market.

Neuropathy, or damage to nerve fibres, is another common and significant complication of diabetes that can lead to pain, loss of sensation in the limbs and in advanced stages, even lower limb ulceration or amputation. When evaluating neuropathy, most tests are of nerve function.

Nerve conduction tests, or electrophysiology (usually of the lower limbs), are advocated as a gold standard because they are objective and repeatable; however, they do not assess small fibre damage and therefore do not reflect functional characteristics of the majority of peripheral nerve fibres.

Sensory testing (the threshold at which hot and cold is detected on the foot) can evaluate small fibre damage but the apparatus for conducting such tests is not readily available and is highly subjective.

Nerve and skin biopsies allow objective and detailed assessment of structural pathology of small fibres. However, they are invasive, painful, can be performed only in highly specialised laboratories and cannot be readily repeated for longitudinal assessment.

Unlike retinopathy, there is currently no standard, well-accepted measure for the diagnosis of neuropathy and several tests have to be employed as a composite measure.[1,2] The motivation to find a suitably sensitive, repeatable marker of diabetic neuropathy is two-fold. First, there are currently no therapeutic agents for the treatment of diabetic neuropathy, with the only means of management being palliative care, early detection and subsequent risk factor modification. It is argued that a major contributing factor in the lack of therapeutic treatments is the lack of suitably sensitive end points in clinical trials.[2]

In the future, optometrists could potentially play an important role in the diagnosis and monitoring of diabetic neuropathy. The cornea, being a transparent yet densely innervated tissue, provides a unique opportunity for the *in vivo* examination of nerve structure, using corneal confocal microscopy (CCM). Over the past decade, this technique has been explored as a novel non-invasive marker of diabetic neuropathy, detecting both nerve degeneration[3,4] and regeneration.[5]

There are three measures currently used in studies to assess corneal nerve morphology. Corneal nerve fibre length (CNFL) is the total length of nerve fibres per square millimetre of corneal tissue (mm/mm^2). Corneal nerve branch density (CNBD) is the number of nerve branches per square millimetre of corneal tissue (number/mm^2). Corneal nerve fibre tortuosity (CNFT) is the degree of non-linearity of the nerve fibres.

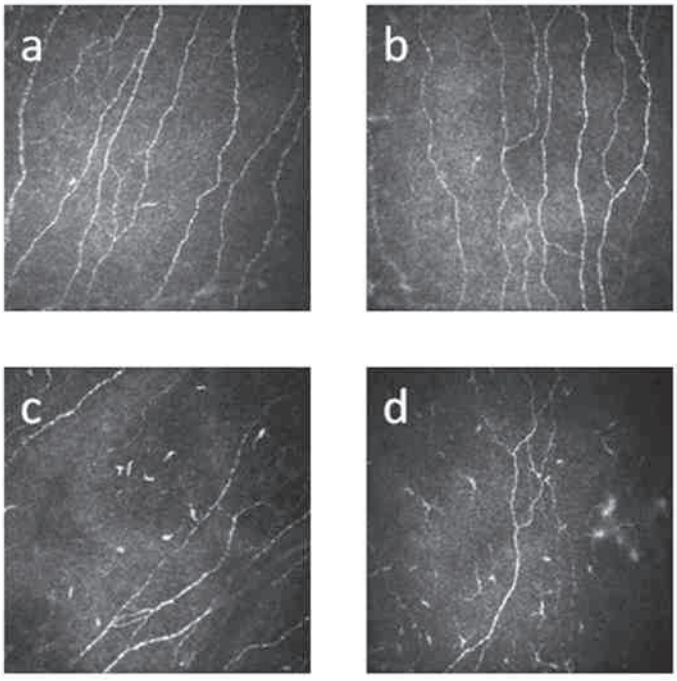


Figure 1. Images of the sub-basal corneal nerve plexus from (A) a non-diabetic control individual and diabetic individuals (B) without neuropathy, and with (C) mild and (D) severe neuropathy

novel ophthalmic diabetic markers

Could *in vivo* examinations of corneal nerve structure be used to detect diabetic neuropathy?

CNFL and CNBD are both reduced with increasing amounts of diabetic neuropathy, while CNFT is increased. Corneal sensation threshold (CST) as measured with non-contact corneal nerve aesthesiometry (NCCA) has also been investigated as a non-invasive ophthalmic marker of diabetic neuropathy.

LANDMark Study

The LANDMark (Longitudinal Assessment of Neuropathy in Diabetes using novel ophthalmic Markers) Study is a five-year observational, longitudinal investigation of individuals with type 1 and type 2 diabetes, and non-diabetic control individuals. This is an international study based at the Anterior Eye Laboratory, Institute of Health and Biomedical Innovation, Queensland University of Technology, Australia and the Centre for Endocrinology and Diabetes, University of Manchester, United Kingdom.

The baseline findings of the Australian site of LANDMark Study were published recently.[6,7] The purpose of the study was to investigate the utility of corneal nerve morphology and function as markers of diabetic peripheral neuropathy.

In summary, the LANDMark Study found that CNFL was significantly reduced in diabetic individuals with mild DPN compared to both controls ($p < 0.001$) and diabetic individuals without DPN ($p = 0.012$). CNBD was significantly reduced in individuals with mild DPN compared to controls ($p = 0.032$). CST was significantly higher ($p = 0.002$) in individuals with mild DPN (0.8 ± 0.7 mbars) compared to both controls (0.6 ± 0.3 mbars) and diabetic individuals without neuropathy (0.6 ± 0.5 mbars).

Figure 1 shows images of the sub-basal corneal nerve plexus from (A) a non-diabetic control individual and diabetic individuals (B) without neuropathy, and with (C) mild and (D) severe neuropathy. All individuals are male and aged 54 or 55 years old, and all those with diabetes are type 2.

The images show an increase in the stages of corneal nerve deficit (reduced CNFL and CNBD and increase CNFT) with increasing level of neuropathy severity. Comparison of Figures 1A (control) and 1B (diabetic without neuropathy) demonstrate that it is not diabetes per se that causes alteration to the nerve fibres.

The LANDMark Study has also been one of the first investigations to consider risk factors for longitudinal changes in corneal nerve deficit and has demonstrated that CNFL is correlated to two of the strongest risk factors for diabetic neuropathy: duration of diabetes and HbA1c.

Recent studies including the LANDMark Study have demonstrated a modest but significant relationship between the morphology and function of corneal nerves, and established tests for diabetic neuropathy. The full potential of these novel ophthalmic markers may not be realised until longitudinal investigation and analysis is complete.

Given the non-invasive and quantifiable nature of this technique, which takes only minimal training to learn, it may become a standard part of diabetic screening by eye-care practitioners in the near future. ■

References are available from j.megahan@optometrists.asn.au, subject: Diabetic markers, *Pharma* June 2013.

Aspirin and increased risk of AMD

Researchers have found that regular aspirin consumption is associated with an increased risk of neovascular age-related macular degeneration (AMD).

A prospective analysis was conducted of data from an Australian population-based cohort with four examinations during a 15-year period. Participants completed a detailed questionnaire at baseline assessing aspirin use, cardiovascular disease status and AMD risk factors. AMD was graded side-by-side from retinal photographs taken at each study visit to assess the incidence of neovascular (wet) AMD and geographic atrophy (dry AMD) according to the international AMD classification.

Of 2,389 baseline participants with follow-up data available, 257 individuals (10.8 per cent) were regular aspirin users and 63 of the 2389 developed neovascular AMD. Persons who were regular aspirin users were more likely to have incident neovascular AMD; the 15-year cumulative incidence was 9.3 per cent in users and 3.7 per cent in non-users.

The study, published in January 2013 issue of *JAMA Internal Medicine*, concluded that regular aspirin use is associated with increased risk of incident neovascular AMD, independent of a history of cardiovascular disease and smoking.

Study co-author Professor Jie-Jin Wang PhD from the Centre for Vision Research, Department of Ophthalmology, University of Sydney, and the Centre for Eye Research Australia, University of Melbourne, acknowledged in an interview with *Medscape Medical News* that the published evidence for an aspirin-AMD link remained inconclusive.

'The study only generates a hypothesis of a possible side-effect of aspirin use but this needs to be confirmed by future studies,' Dr Wang said.

JAMA Intern Med 2013;173: 4: 258-264. ■

Presumed ocular histoplasmosis bevacizumab

The anti-VEGF medication offers POHS sufferers help to maintain or restore their vision.

Case report

Casandra S Solis BA
Dr Leonid Skorin Jr
OD DO MS FAAO FAOCO
Mayo Clinic Health System,
Albert Lea MN

Presumed ocular histoplasmosis syndrome (POHS) is a specific triad of ocular changes that consist of peripapillary atrophy, peripheral 'punched-out lesions' or choroidal scars and a choroidal neovascular membrane (CNVM). It is believed that POHS is caused by the *Histoplasma capsulatum* fungus. This fungus is endemic in certain parts of the world and is found in soil containing bat or bird droppings.[1-4]

A 39-year-old Caucasian female was referred for a POHS consultation from her optometrist. Case history indicated the patient had grown up with chickens in northern Minnesota USA, an area where *H capsulatum* is endemic. The patient denied pregnancy and the history was otherwise unremarkable.

She presented with a report of a recent onset of blurred, distorted vision in her right eye and long-standing blurred vision in her left eye. Distance visual acuity (VA) measured R 6/21-2 with no improvement on pinhole and L 6/15-2 with slight improvement to 6/15+2 on pinhole. Near VA measured R 6/12 and L 6/12. There was no improvement of VA in either eye with refraction.

Amsler grid testing in the right eye showed distortion of the whole grid left of fixation. The Amsler grid in the left eye had no distortion. The anterior segment was found to be unremarkable.

The dilated fundus exam (DFE) revealed a cup to disc ratio of 0.2 in both eyes with peripapillary atrophy around both optic nerve heads. Both eyes had evidence of 'punched-out' lesions and hypopigmented changes in the periphery. In addition, the right eye presented with macular elevation and neovascular changes with haemorrhages (Figure 1). The left macula was flat and dry (Figure 2). No vitritis was noted in either eye.

Optical coherence tomography (OCT) showed evidence of large amounts of fluid within the layers of the retina, confirming oedema in the right eye (Figure 3). The left eye displayed evidence of subretinal thickening with no active oedema.

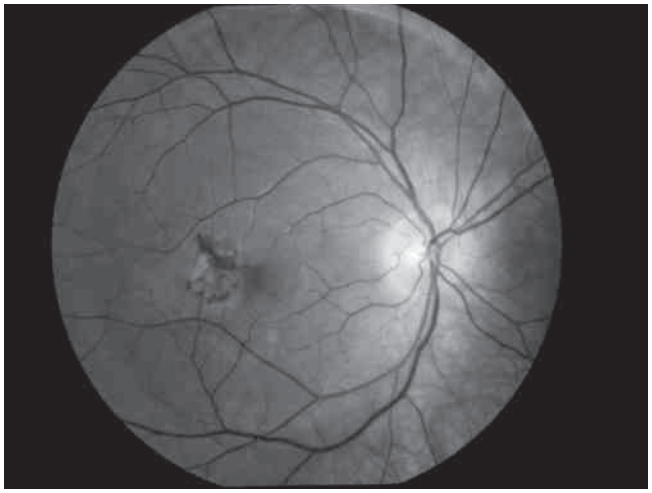


Figure 1. Right eye macular haemorrhage as seen with red-free filter

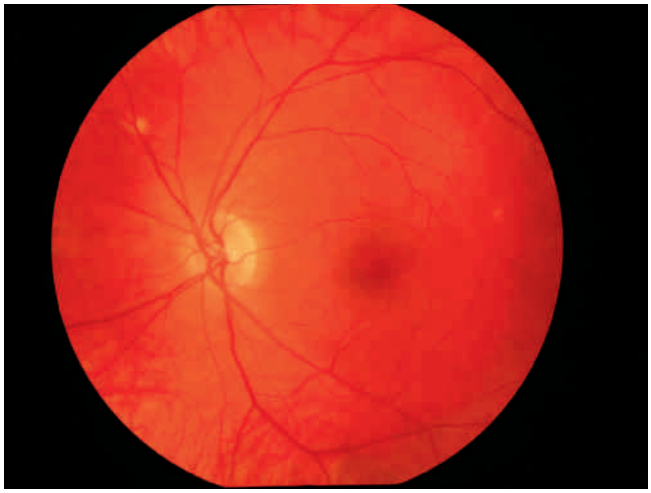


Figure 2. Left eye peripapillary atrophy and 'punched-out' lesions

syndrome treated with

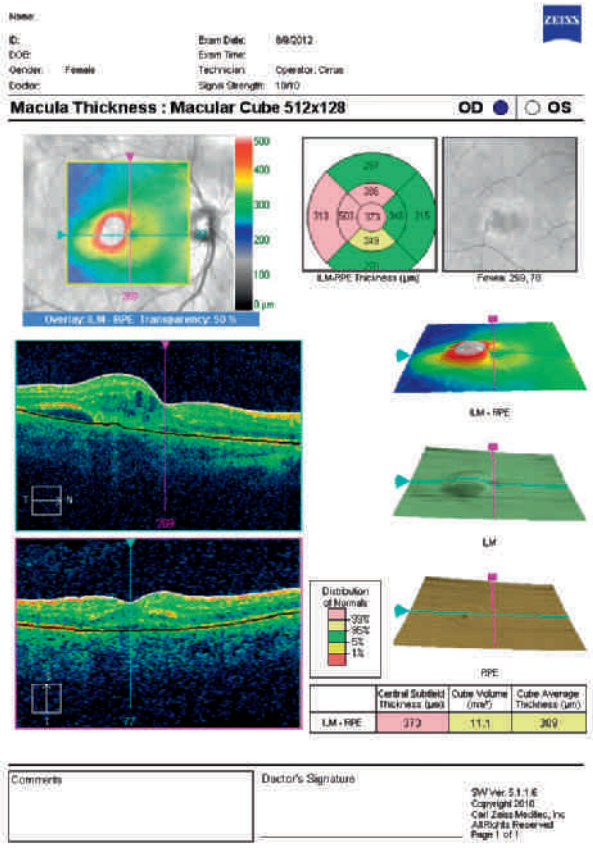


Figure 3. Significant macular oedema on right eye OCT

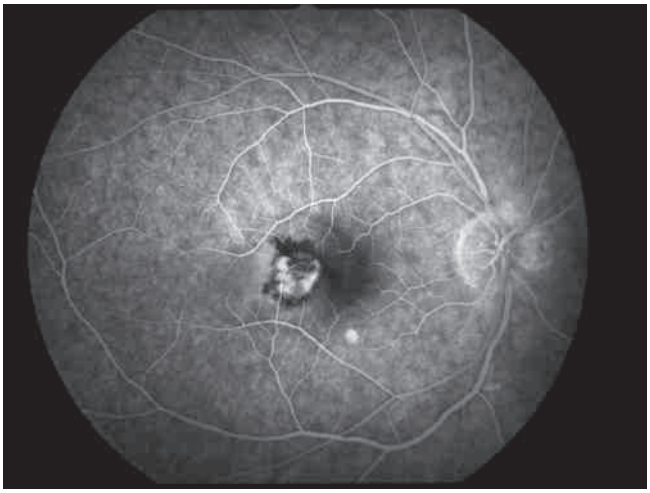


Figure 4. Early FANG right eye showing hyperfluorescence of the CNVM and of the choroidal vasculature through the 'punched-out' lesion inferior to the macula

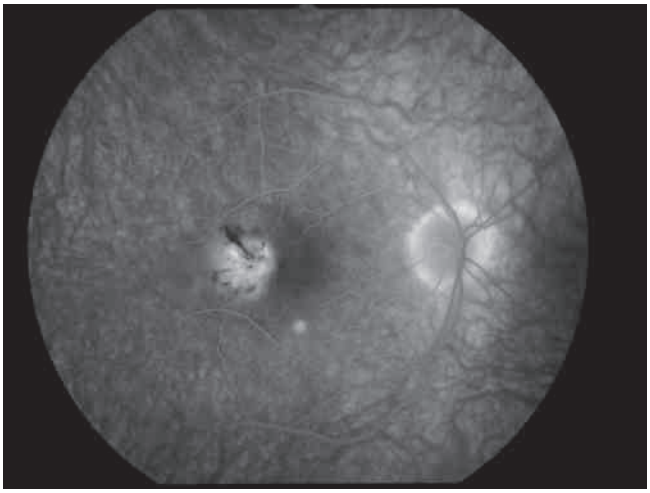


Figure 5. Late FANG right eye showing hyperfluorescence and oedema of the macular region. Hyperfluorescence of the choroidal vessels can be seen surrounding the optic disc beneath the peripapillary atrophy.

Diagnosis

A diagnosis of POHS with an active choroidal neovascular membrane (CNVM) in the right eye was confirmed with fluorescein angiography (FANG). The FANG displayed the extent of the oedema with hyperfluorescence in both early and late stages. In addition, the choroidal vasculature can be viewed showing hyperfluorescence through the atrophic 'punched out' lesions in the periphery (Figures 4 and 5).

Due to the confirmation of oedema and an active CNVM by both OCT and FANG, the possibility to treat with an intravitreal injection of bevacizumab (Avastin, Genentech Inc, South San Francisco CA) was presented to the patient. Potential benefits and side-effects were discussed and the patient decided to pursue the injection.

Treatment

1.25 mg of bevacizumab was injected intravitreally 4 mm posterior to the limbus in the inferior temporal region under aseptic conditions. Erythromycin ophthalmic ointment was instilled into the right lower fornix following the injection. The patient was given erythromycin ophthalmic ointment to instil in her right lower cul-de-sac twice a day for the following three days. She was informed of the symptoms of retinal detachment and endophthalmitis, and was instructed to call or return to the office immediately if any were noted. A follow-up visit was scheduled for five weeks.

Follow up

At her first follow-up visit, the patient reported a subjective improvement in vision. Her distance visual acuity had improved to R 6/9-1 with improvement on pinhole to 6/7.5-1. Her right Amsler grid was much improved with a slight area of superior distortion remaining.

Continued page 8

Histoplasmosis

From page 7

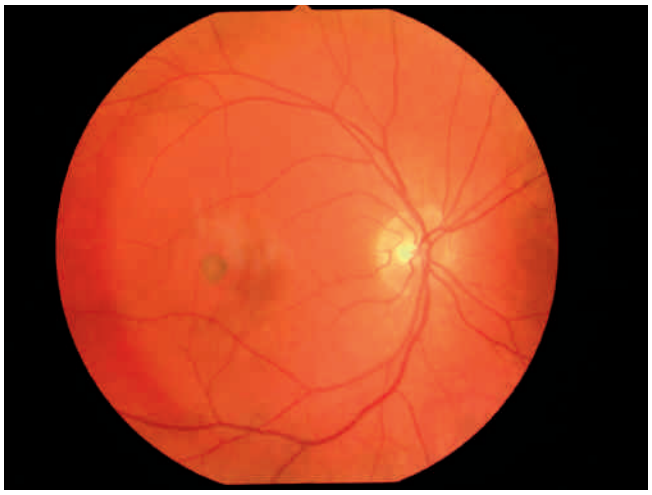


Figure 6. Histoplasmosis scar and remaining oedema indicated by haze on photograph, five weeks after initial injection of bevacizumab

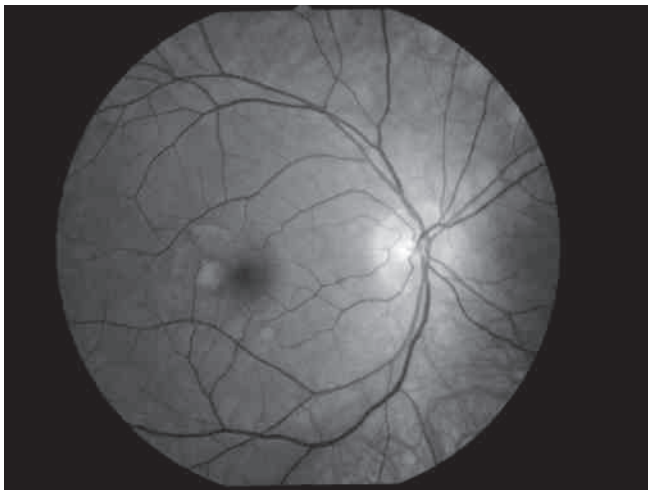


Figure 8. Right eye six weeks after the second injection. Note the demarcation lines that indicate the extent of original oedema.

The posterior segment showed a complete resolution of the haemorrhage in the right eye (Figure 6). A perifoveal histoplasmosis scar was present just temporal to the macula. A positive foveal light reflex was noted. Positive Watzke-Allen testing confirmed the presence of mild oedema. The OCT showed a significant decrease in oedema from the previous visit (Figure 7). Due to the continued presence of oedema, a second bevacizumab intravitreal injection was given on this visit.

Continued page 11

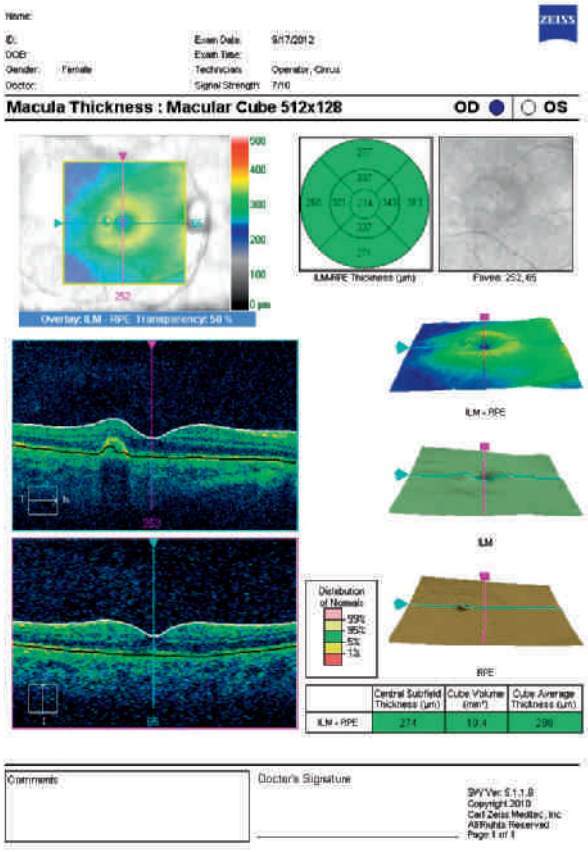


Figure 7. OCT right eye five weeks after first injection indicating significant decrease in oedema

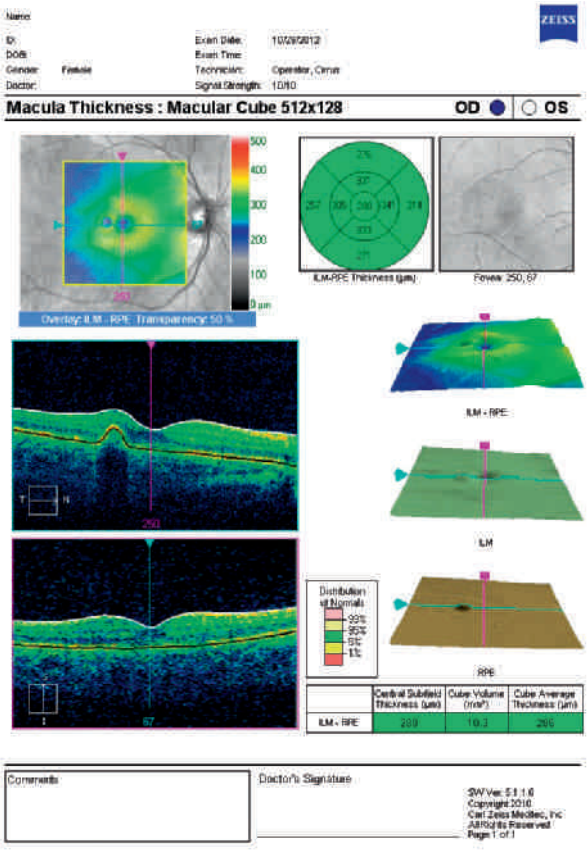


Figure 9. OCT right eye histoplasmosis scar six weeks following the second injection. Compare with Figure 3 (initial OCT).

Allergies are rising

the ocular response

One in four Australians could suffer from allergies by 2050, if current predictions are correct.

Kate Johnson
BAppSc(Optom)Hons
GradCertOcTher FBLCA
FIACLE FCCLSA FAAO

The frequency of allergic disease has approximately doubled in the past 25 years and 4.1 million Australians (19.6 per cent) have at least one allergy—one of the highest rates in the developed world. The highest prevalence of allergies is in the working population, with 78 per cent of sufferers aged between 15 and 64 years. It is predicted that by 2050, the proportion of the population with allergies will increase to 7.7 million, or over 25 per cent of Australians, if current trends continue.[1]

Table 1 lists the frequency of many common forms of allergy in Australia.

Allergies significantly affect quality of life. Hayfever can lead to poor quality sleep and consequential daytime sleepiness in children and adults, which can cause problems with concentration and recalling information. Sufferers can be irritable and distracted and find it harder to make decisions. In children, health-related quality of life issues include learning impairment, social integration difficulties from activity restriction and symptom management, and anxiety.[2] Untreated allergies can also worsen other chronic respiratory problems like asthma and sinusitis as well as skin disorders like eczema and urticarial (hives).

The symptoms of ocular allergy can range from epiphora, hyperaemia and itchiness, to severe pain and ocular surface scarring. Dry eye syndrome can also be a frequent consequence of ocular allergy. A survey of almost 900 paediatric allergy cases in 2008 found a 90 per cent association between concomitant allergic rhinitis and allergic conjunctivitis.

Children with allergic conjunctivitis show a 70 per cent incidence of eczema and a 30 per cent incidence of asthma. It is imperative that primary eye-care practitioners ask all patients about history of allergy, and advise all rhinitis sufferers of the symptoms and management of ocular allergy due to the likelihood that almost all will suffer the two simultaneously.[3]

Allergy response

An allergy is an over-reaction of the immune system to a particle or substance that would not usually create an immune response. An allergen may be a microbe or toxins like chemicals, drugs or other foreign particles.

The normal immune reaction to a foreign particle (pathogen) involves the injured cell stimulating both a chemical and a cellular response. The chemical response commences when damaged cells release cytokines and eicosanoids, which trigger the inflammation response. Cytokines, such as interleukins and interferons, are responsible for signaling cell communication and movement to the injured area. Eicosanoids, such as the prostaglandins and leukotrienes, are responsible for the inflammatory responses of pain, heat, hyperaemia, oedema and loss of function.

The cellular response involves the release of specialised white blood cells: antibodies to particular antigens if they have been encountered before. The antibodies are produced by specialised lymphocytes (white blood cells) called B cells, which along with T cells are responsible for directly attacking the pathogen and assisting the demise of infected cells. The cellular response is termed 'the adaptive immune system', as it is learned through priming to specific pathogens and reacts quickly for their elimination. The chemical response is a generic reaction to a pathogen regardless of its previous presentation, termed 'the innate immune system'.

The normally functioning innate immune system also comprises further specialised white blood cells called leukocytes, which include mast cells, basophils, eosinophils, natural killer cells and phagocytes (macrophages, neutrophils and dendritic cells). Leukocytes have specific individual functions centred around identifying and eliminating pathogens.

Allergy is also described as a Type 1 hypersensitivity reaction, which is immediate and predictable. In the allergy response, a specific type of antibody called immunoglobulin E (IgE) activates the chemical component of the immune system by binding specifically to mast cells and basophils.

These sensitised cells, which are both involved in the normal acute inflammatory

Continued page 10

1 in 5	Allergies (of any form)
1 in 5	Asthma (children) Allergic rhinitis (hayfever) in adults
1 in 8	Eczema (children)
1 in 10	Asthma (adults) Allergic rhinitis (hayfever) in children
1 in 20	Food allergy (usually transient)
1 in 50	Children with peanut allergy
1 in 100	Life threatening allergy (anaphylaxis)

Table 1. Frequency of many common forms of allergy in Australia

Allergies

From page 9

response, are primed to react and on later exposure to the same allergen, undergo a process called degranulation, where histamine, eicosanoids and leukotrienes are released into the surrounding tissue, stimulating the vascular, nerve and muscle changes responsible for symptomology. An individual can react to an allergen locally, such as in seasonal allergic conjunctivitis or rhinitis (hayfever), or system-wide such as in anaphylaxis.

Further examples of Type 1 immediate hypersensitivity reactions include atopy, anaphylaxis and asthma. Other types of hypersensitivity reactions include an autoimmune response (Type 2), such as Myasthenia Gravis; Type 3 immune complex diseases where an antibody and antigen complex bind together to deposit in tissues and affect function, such as rheumatoid arthritis and Sjögren's syndrome; and Type 4 delayed hypersensitivity, which is driven by T-cells and occurs due to cell-mediated immune memory, independent of antibodies. Examples of Type 4 hypersensitivities include contact dermatitis, multiple sclerosis and chronic transplant rejection. Some ocular allergies incorporate both Type 1 and Type 4 responses.[4,5,6]

Ocular allergies can be grouped into the following conditions: seasonal and perennial allergic conjunctivitis (SAC and PAC); giant papillary conjunctivitis (GPC, also knows as contact lens papillary conjunctivitis or CLPC); vernal keratoconjunctivitis (VKC) and atopic keratoconjunctivitis (AKC).[7]

Seasonal and perennial allergic conjunctivitis

SAC is an IgE mediated hypersensitivity reaction and 80 per cent of cases occur in patients under 30 years of age. It is usually intermittent, related to pollen allergens and allergic rhinitis (hayfever). PAC is the ongoing version of SAC. It is also IgE mediated and is related to ongoing exposure to year-round allergens like dust mites, mould and animals. It is also related to ongoing sinusitis.

Both SAC and PAC lead to ocular surface irritation including symptoms of itch, epiphora, hyperaemia and a velvety, oedematous conjunctiva. It should resolve without scarring.

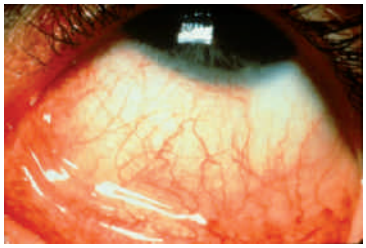
Giant papillary conjunctivitis/contact lens papillary conjunctivitis

GPC/CLPC represents both a Type 1 (IgE mediated immediate allergy) and Type 4 (delayed T-cell mediated) hypersensitivity responses. It has no gender or age prominence, and it universally affects the upper tarsal plate, most frequently in contact lens wearers. Causes can be grouped into either mechanical or chemical allergy components of the reaction. Mechanical causes of GPC, aside from the presence of a contact lens, can include lid eversion in floppy eyelid syndrome; ocular prostheses and post-operative sutures. Chemical allergy causes include contact lens solutions and preservatives, and contact lens/ocular prosthesis depositing.[8]

The upper tarsal plate passes over the contact lens edge 20,000 per day. A common contact lens complication occurring in four to 30 per cent of wearers, GPC is also one of the most common reasons for discontinuation of contact lens wear.[9] GPC may lead to temporary or permanent contact lens intolerance, so the contact lens practitioner must be vigilant about ongoing monitoring for early signs of this condition, and in minimising patient risk by ensuring proper lens and case replacement frequency, correct care and maintenance procedures, suitability for lens material and solution combinations, and the minimisation of preservative exposure in sensitized individuals.

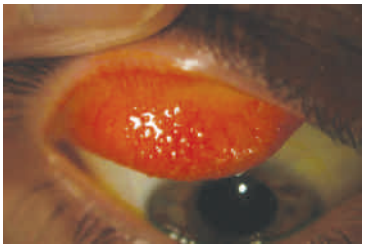
Cases of GPC must be managed quickly and moved efficiently towards resolution in

Summary of ocular allergic conditions



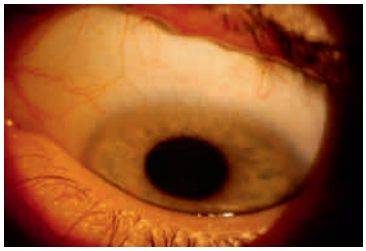
Seasonal allergic conjunctivitis and perennial allergic conjunctivitis (SAC and PAC)

- SAC: 80% under 30 years of age
- Related to seasonal allergies and allergic rhinitis (hayfever)
- PAC related to year-round allergen exposure
- Itch, epiphora, hyperaemia, conjunctival oedema



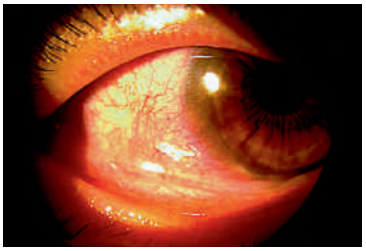
Giant papillary conjunctivitis/contact lens papillary conjunctivitis (GPC/CLPC)

- Upper tarsal papillae
- Mechanical or chemical irritation, associated with contact lens wear
- Occurs in 4-30% of contact lens wearers



Vernal keratoconjunctivitis (VKC)

- Onset before age 10, may resolve at puberty
- Bilateral in 96% of cases
- Males 3:1 ratio
- Papillary reaction (giant upper tarsal papillae)
- Limbal reaction (Horner-Trantas dots)
- Shield ulcers



Atopic keratoconjunctivitis (AKC)

- Lifelong condition starting in late teens, more frequent in men
- Occurs in 25-40% of patients with atopy
- Chronic eczematous blepharitis
- Inferior one-third of cornea: punctate erosions, ulcers, neovascularisation, pannus
- Inferior conjunctival scarring and symblepharon
- Association with keratoconus and PSCC

all contact lens wearers, especially those for whom contact lenses serve as primary vision correction, such as in keratoconus.

Vernal keratoconjunctivitis

VKC is a severe inflammatory disease which can be intermittent or persistent, and is more frequent in hot, dry climates. It is bilateral in 96 per cent of cases, with an association with atopy in 15-60 per cent of cases. Most intermittent cases are seasonal and pollen associated. It is a Type 1 and Type 4 hypersensitivity reaction.

Onset of VKC is usually before age 10 and males are affected in a 3:1 ratio compared to females. VKC can resolve at puberty or can progress to AKC. Symptoms include epiphora, difficulty opening eyes in the morning and photophobia. Giant papillary hyperplasia of the upper tarsal plate can be present, with erosion of the corneal epithelium and inflammation at the limbus (Horner-Trantas dots) which can lead to corneal scarring through development of chronic, non-healing epithelial defects called 'Shield ulcers'.[10,11]

Atopic keratoconjunctivitis

AKC is a severe inflammatory disease associated with atopic eczema. It is a life-long condition, which usually starts in the late teens to early 20s, with a peak incidence in the 30 to 50 years age group. It is also more frequent in men, as is VKC. AKC occurs in 25 to 40 per cent of patients with atopic eczema, and usually with a personal or family history of atopic disease. AKC sufferers can demonstrate atopic blepharitis with scaly, eczematous skin and lid swelling. Unlike VKC, AKC conjunctival changes are usually located inferiorly, with the inferior one-third of the cornea also more likely to develop punctate erosions, keratitis, ulcers, pannus and neovascularisation.

Papillary hypertrophy of the tarsal conjunctiva can eventually be accompanied by cicatrisation and symblepharon formation in the inferior fornix. An association exists between keratoconus and AKC, postulated to be due to aggressive mechanical pressure from eye-rubbing weakening the cornea. Atopic patients can also develop posterior sub-capsular cataracts, which may or may not be due to prolonged use of steroid treatment.[11]

Ocular allergy treatment

Use of cold compresses and medications is helpful to all ocular allergy sufferers, as a counter to the heat response generated by histamine. SAC and PAC may respond well to antihistamine-mast cell stabiliser combination medications like ketotifen fumarate (Zaditen) and olopatadine (Patanol). GPC can also be managed similarly, with consideration of changes to contact lens material, solutions or wearing habits to reduce mechanical and chemical insult to the upper tarsal plate. More severe cases of SAC, PAC and GPC may require topical steroid use, such as fluorometholone (FML, or acetate-Flarex).

Contact lens wearers suffering GPC will benefit from use of hydrogen peroxide lens maintenance systems and where suitable, reducing lens wearing time or modality such as with daily disposable lenses. Where daily disposable contact lenses are not suitable, such as in keratoconus, surface polishing, frequent protein removal treatment and lens replacement can also assist.

VKC and AKC may involve ongoing use of antihistamine-mast cell stabiliser medications and topical steroids. Topical antibiotics may be required where corneal ulceration has occurred, especially with concurrent blepharitis, where the atopic patient is at higher risk of staphylococcus infection. Non-steroidal anti-inflammatory medications may also play a part for long-term therapy where ongoing use of steroid medications is not desirable due to increased risk of superinfection, glaucoma and cataract.[11] VKC and AKC patients may require comanagement with an allergist, dermatologist and ophthalmologist.

All ocular allergies result in tear film disturbance—overproduction of mucous by the injured conjunctiva reduces tear quality and stability. In addition, antihistamines can dry the ocular surface and preservatives in steroids and antibiotics can cause further irritation. Preservative-free ocular lubricants are an important adjunct therapy in all ocular allergy patients to assist in attainment of improved ocular comfort.

Ocular allergies can range from being a mild irritation to sight-threatening, and the increasing frequency of ocular and systemic allergies should lead all primary eye-care practitioners to ensuring their full understanding of the diagnosis and management of ocular allergic conditions. ■

References are available from j.megahan@optometrists.asn.au, subject: Allergies, *Pharma* June 2013.

Histoplasmosis

From page 8

On the patient's second return visit, distance VA in the right eye had returned to 6/6. DFE revealed a complete reduction in swelling (Figure 8). The macular disciform scar was still present, which caused a slight curve in the Watzke-Allen test. The patient reported that the curve was much smaller than on previous examinations. The OCT indicated no oedema and only a slight thickening of the retina in the location of the macular scar (Figure 9). A follow-up examination was scheduled in two months. The patient was given an Amsler grid to monitor for any changes at home.

Conclusion

While POHS is often endemic to specific areas, it should be noted that some studies have identified the classic triad of peripapillary atrophy, 'punched-out' lesions and CNVM in populations that have had no contact with *H capsulatum*.[3] Therefore, all eye-care professionals should be aware that this condition could present even without the classic exposure history.

Prior to the introduction of injectable anti-vascular endothelial growth factor (anti-VEGF) medication, treatment options for CNVM from POHS were limited. Treatment options consisted of observation, thermal or photodynamic laser photocoagulation, submacular surgery to remove the membrane, or intravitreal corticosteroids.[1-3] Most options, such as laser photocoagulation, provided little benefit to preserve vision and often served only to halt the production of new vasculature.

Anti-VEGF medication, originally developed for cancer treatment and currently used for exudative age-related macular degeneration, has given those who are afflicted with POHS an option that can help to maintain or restore their vision. ■

1. Cionni D, Lewis S, Petersen M et al. Analysis of outcomes for intravitreal bevacizumab in the treatment of choroidal neovascularization secondary to ocular histoplasmosis. *Ophthalmology* 2012; 119: 327-331.
2. Ehrlich R, Ciulla T, Maturi R et al. Intravitreal bevacizumab for choroidal neovascularization secondary to presumed ocular histoplasmosis syndrome. *Retina* 2009; 29: 1418-1423.
3. Prasad A, Van Gelder R. Presumed ocular histoplasmosis syndrome. *Curr Opin Ophthalmol* 2005; 16: 364-368.
4. Chheda L, Ferketich A, Carroll CP et al. Smoking as a risk factor for choroidal neovascularization secondary to presumed ocular histoplasmosis syndrome. *Ophthalmology* 2012; 119: 333-338.

OCT
Look beyond the macula and optic nerve

Practitioners are finding OCT technology useful in investigating structural anomalies in many eye tissues, not just the retina.

Roman Serebrianik
Lead Optometrist Primary Care
Australian College of Optometry

Because of the unique, optically-clear pathway through the eye, optical coherence tomography (OCT) has been used most extensively for the study and imaging of disorders affecting the subtle architecture of the retina (age-related macular degeneration, central serous retinopathy, clinically significant macular oedema, vitreomacular traction, epiretinal membrane and so on). Because OCT is able to tease out and separate various layers comprising the retina based on their optical density, it has also proved indispensable in the analysis of retinal nerve fiber layer (RNFL) integrity and more recently, macular ganglion cell layer in glaucoma diagnosis and monitoring.

The unique virtual transparency of the internal structures of the eye enable an OCT beam to penetrate not only the retina but also the retinal pigment epithelium (RPE), Bruch's membrane to show the vasculature of the choroid. (Figure 1)

Consequently, OCT has quickly become an important tool in the diagnosis and management of macular degeneration—especially for guidance of anti-VEGF injections in exudative AMD, as well as analysis of geographic atrophy and drusen in atrophic disease.

Current OCT devices offer a wide range of scanning modalities, which enable the technology to be adapted for investigation of structural anomalies in many tissues of the eye and consequently, a great range of ophthalmic conditions.

When clinicians discuss OCT, I find many think of its numerous applications in the posterior segment, but anterior segment OCT (AS-OCT) also provides a wealth of uses in patient evaluation, for example: cornea, drainage angle, anterior chamber and refractive surgery assessment.

AS-OCT allows visualisation of corneal layers, corneal thickness, anterior chamber depth, drainage angle, refractive surgery evaluation and many others. One disadvantage of AS-OCT is its inability to penetrate the iris pigment epithelium, which makes it impossible to evaluate the structures behind the iris (for example, ciliary body) for which ultrasonography may be used.

AS-OCT has proved to be extremely useful in managing many conditions, from anterior segment pathology (microbial keratitis), corneal ectasias (keratoconus) to drainage angle visualisation in glaucoma diagnosis (angle closure glaucoma, plateau iris and so on).

Because OCT is very versatile in clinical practice, its technology can be adapted for the study of a wide range of ophthalmic conditions. Below is a brief sampling of some of the novel or at least, less common uses of OCT technology that I have found useful to complement macular and optic nerve analysis in my clinical experience.

Contact lens practice

Anterior segment OCT readily allows high-

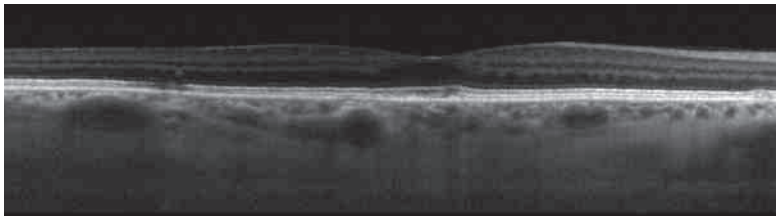


Figure 1. Enhanced depth imaging (EDI) of the macula, including resolution of the RPE and choroidal architecture. Heidelberg Engineering Spectralis OCT.

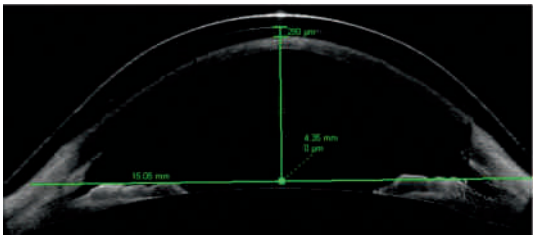


Figure 2. Miniscleral lens *in situ* on the cornea. Note lens edge extending past limbus, lens sagittal depth and tear film clearance caliper. Image: Dr A Bruce, ACO. Zeiss Visante OCT.

Figure 3. Rust ring from an old corneal foreign body. Note surrounding scarring and a second, older scar below, at the 6 o'clock position.

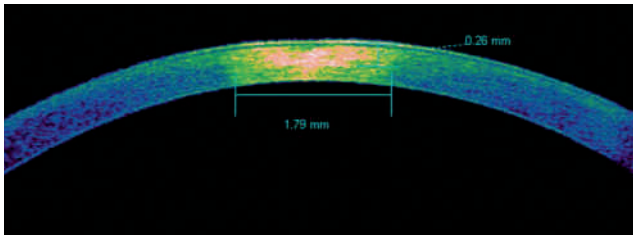


Figure 4

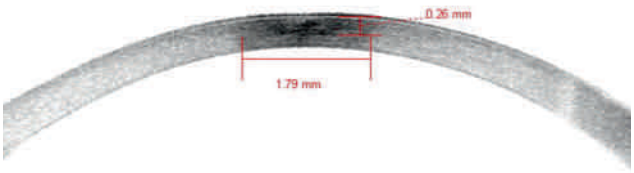


Figure 5

Enhanced high resolution corneal scan of the area, in colour and greyscale, localising depth and size of scarring. Zeiss Visante OCT

resolution analysis of the cornea and tear film. This concept can be expanded, by imaging contact lenses *in situ* on the cornea.

While you can readily visualise both soft and rigid gas permeable lenses, OCT enables real-time assessment of the tear film under the RGP in complex post-graft or scleral/miniscleral lenses, where the lens selection is determined not by keratometric values, but by central sagittal depth of the lens. Similarly, RGP-cornea interactions can also be readily visualised and assessed, for example, in persistent 3 and 9 o'clock staining (Figure 2).

Corneal scars and opacities

Anterior segment OCT is exceptional at providing high-resolution scans of the cornea. It may be used to not only localise but also to quantifiably measure the depth of corneal scars and opacities. These are useful not just for diagnosis and for considering whether therapeutic surgical or laser keratoplasty procedures are feasible (Figures 3, 4, 5).

Pterygium and other similar surface lesions

Finding a pterygium encroaching past the limbus onto the cornea is especially common in UV-bathed Australia but determining exactly where the lesion ends may be difficult, as the leading edge often extends further than the visible membrane. The AS-OCT is excellent at pin-pointing the exact location where the corneal epithelium meets the edge of the pterygium, and the caliper tool is able to accurately measure and monitor progression of the lesion over time.

The ensuing disruption by the pterygium to the morphology of outer corneal layers can be clearly observed on the OCT scan, and the corresponding loss of transparency can also be appreciated. Note the typical shadowing of deeper corneal layers on the pterygium side of the junction. For more on this, see Mohamed Soliman's recently-published study of OCT examination of pterygium and pinguecula[1] (Figures 6 and 7).

Pre-retinal/vitreous fibrosis

Because OCT allows the study of tissues of variable optical density, its use is not limited to the anterior segment or retinal architecture. When the vitreous body is intact, it does not elicit much signal deviation on OCT. However, vitreous irregularities such as Weiss rings floaters, epiretinal membranes, asteroid hyalosis and others can be readily observed on OCT.

Figure 8 is an example of pre-retinal vitreous fibrosis, following a resolved vitreous haemorrhage secondary to trauma. While the fibrosis is also clearly observed on fundoscopy, to truly appreciate the delicate net of tractional tendrils in two dimensions and three-dimensions, the OCT is unrivalled.

Choroidal melanoma and other pigmented fundus lesions

Choroidal melanoma is a malignant neoplasm of melanocyte cells in the uveal tract and is the most common primary malignancy in adults. Because of its tendency for metastasis and threat to life, accurate diagnosis is crucial. OCT technology is excellent for the study of pigmented lesions in the choroid, as it allows not only measurement of growth and elevation, but may also be more accurate than ultrasonography for tumour size estimation, and study of the overlying retinal structure.[2]

Unlike benign pigmented lesions such as choroidal nevi or CHRPE (congenital hypertrophy of the retinal pigmented epithelium), choroidal melanomas are more likely to be associated with increased tumour thickness, overlying retinal elevation, photoreceptor loss, intra-retinal oedema, sub-retinal

Continued page 14

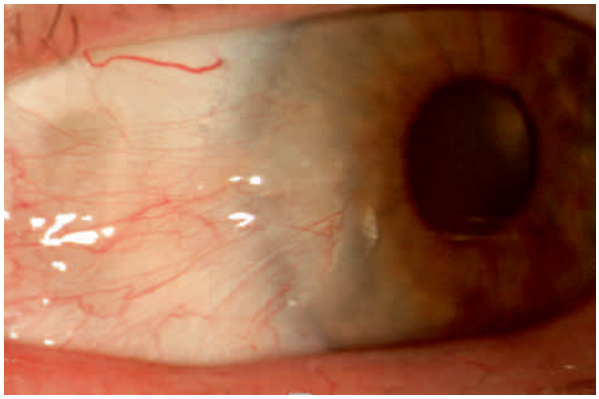


Figure 6. Slitlamp photograph of pterygium

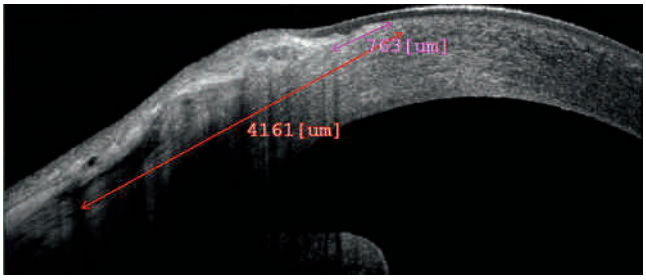


Figure 7. Pterygium-cornea junction. Note the deeper tissue shadowing under the pterygium; disrupted superficial cornea morphology, and leading edge of pterygium morphing into the corneal surface (purple caliper). Nidek RS-3000 Advanced OCT.

OCT

From page 13

fluid accumulation and sub-retinal lipofuscin accumulation[3] (Figures 9, 10 and 11).

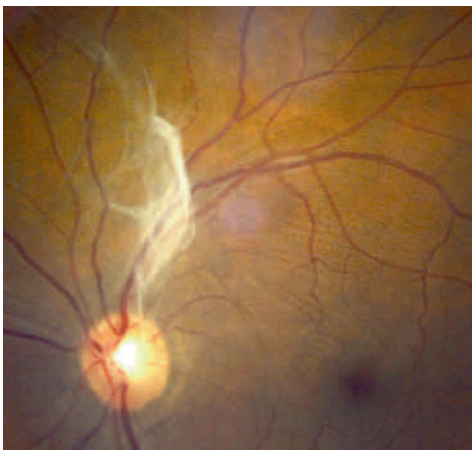
OCT technology offers countless uses to the dedicated and curious clinician, and it would be impossible to list them all even briefly in this forum.

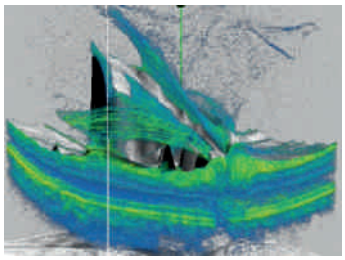
OCT is a fantastic clinical tool in our imaging armory. Once you are familiar with it, OCT becomes an indispensable tool for daily examinations of anterior and posterior segments.

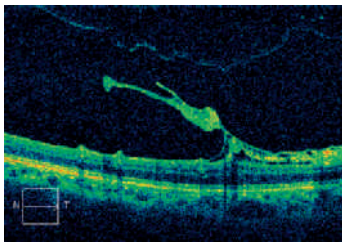
Now is an exciting time for OCT technology. The technical capabilities of the devices are improving in areas such as gaze tracking/image stabilisation technology, enhanced depth imaging, concurrent fundus photograph, autofluorescence.

There is an excellent range of OCTs on the market, and the cost of technology is becoming more attractive. This is great news for the clinical care we are able to deliver for our patients. ■

1. Soliman W, Mohamed T. Spectral domain anterior segment optical coherence tomography assessment of pterygium and pinguecula. *Acta Ophthalmol* 2012; 90: 5: 461-465.
2. Shields C, Kaliki S, Rojanaporn D et al. Enhanced depth imaging optical coherence tomography of small choroidal melanoma: comparison with choroidal nevus. *Arch Ophthalmol* 2012; 130: 7: 850-856.
3. Shah S, Kaliki S, Shields C et al. Enhanced depth imaging optical coherence tomography of choroidal nevus in 104 cases. *Ophthalmology* 2012; 119: 5: 1066-1072.







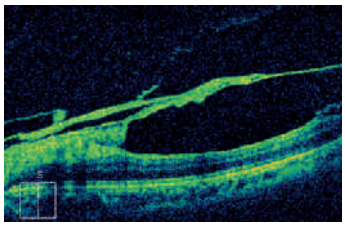


Figure 8. Fundus photograph showing vitreous fibrosis and pre-retinal traction lines. 3D modelling (right) reveals tendrils of traction while macular map scans show vitreous condensation and vitreous-retinal traction. Zeiss Cirrus 4000

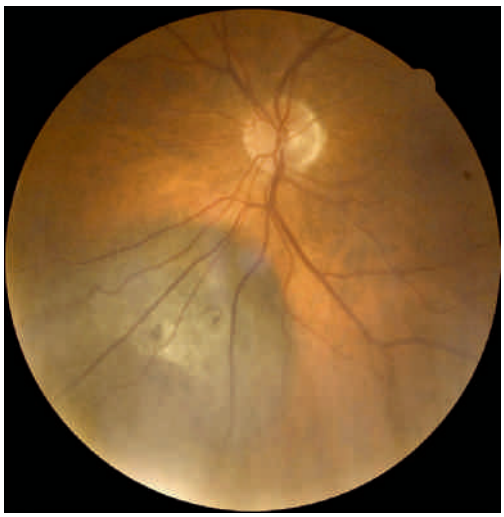
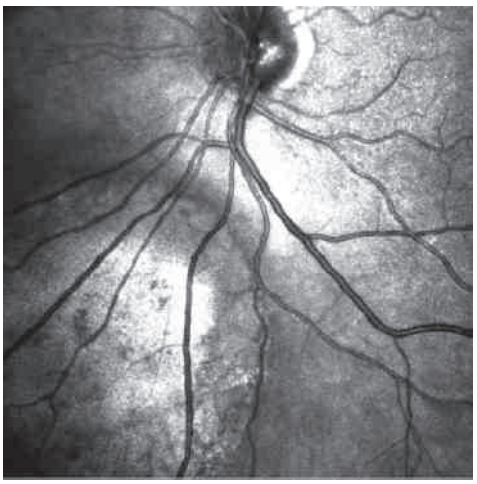


Figure 9. Fundus photograph showing a pigmented choroidal lesion, currently undergoing further investigations as choroidal melanoma. Note apparent retinal elevation (deviated retinal blood vessels) and mottled appearance.



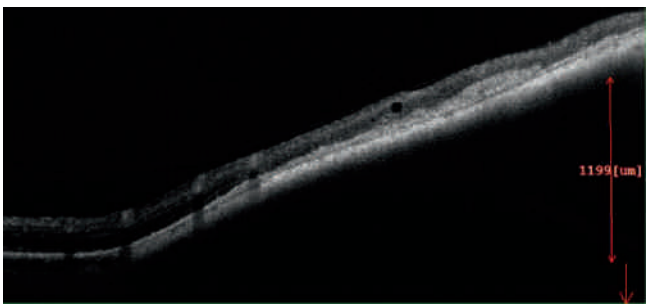


Figure 10 **Figure 11**

Macular line scans showing sharp elevation of the retina at the lesion juncture and intraretinal irregularities. Nidek RS-3000 Advanced OCT

Abstracts

Dr Laura Downie
BOptom PhD(Melb)
PGCertOcTher FACO
DipMus(Prac) AMusA

Corneal endothelial cells and accelerated cellular senescence in HIV

Cellular senescence, that is, the stable and long-term loss of proliferative capacity in cells, has been proposed as a potential key factor in human-immunodeficiency virus (HIV)-related premature biological ageing.

This case-control study assessed features of corneal endothelial cells that are recognised to be associated with the normal ageing process and cellular senescence markers in HIV-infected adults (n = 242). Among HIV-infected adults, 88 per cent were receiving anti-retroviral therapy (ART). A total of 249 age-matched healthy subjects served as the control group. The median age of both groups was 40 years.

HIV-infection was associated with increased odds of variation in endothelial cell size (OR = 1.67; 95% CI: 1.00-2.78, p = 0.04). Among HIV-infected subjects, a low corneal endothelial-cell count was independently associated with a current CD4 count < 200 cells/μL.

It was concluded that the corneal endothelium shows features consistent with HIV-related accelerated senescence. The authors suggested that the evaluation of corneal endothelial cells in longitudinal studies of HIV-related accelerated biological aging may reveal further insights into the mechanisms of cellular senescence in this population.

PLoS One 2013; 8: 2: e57422.

Influence of multifocal IOLs on standard automated perimetry test results

Multifocal intraocular lenses (MFIOLs) can be used to minimise spectacle dependence following cataract surgery. This cross-sectional, case-control study evaluated the influence of MFIOLs on standard automated perimetry (SAP).

Sixteen eyes with a diffractive MFIOL were compared with 18 age-matched, phakic healthy eyes (serving as controls) and 12 age-matched patients with a monofocal IOL. All participants underwent a 30-2 SITA standard strategy with stimulus size III and a full-threshold test with stimulus size V (Humphrey Visual Field Analyzer). Comparisons between groups were adjusted for age and pupil size.

For SAP size III, the average difference in mean defect between patients in the MFIOL and phakic group was -2.40 dB (p < 0.05); there was no significant difference between the phakic and monofocal IOL groups. A similar effect was observed for the SAP size V mode.

The authors concluded that these results suggest that diffractive MFIOLs have a clinically significant reduction in visual sensitivity that may interfere with the assessment of common ocular diseases, such as glaucoma.

JAMA Ophthalmol 2013; 131: 4: 481-485.

Lutein and zeaxanthin supplementation in patients with early AMD

Oral supplementation with lutein and zeaxanthin has been shown to improve macular pigment density and visual function in patients with early age-related macular degeneration (AMD).

This randomised, double-masked, placebo-controlled clinical trial conducted in China involved 108 patients, aged 50-79 years, with early AMD. Participants were randomly assigned to receive one of four treatments (n = 27 per group): 10 mg/day lutein, 20 mg/day lutein, 10 mg/day lutein plus 10 mg/day zeaxanthin or placebo for 48 weeks.

Macular pigment optical density (MPOD) and visual function variables were measured at baseline, 24 and 48 weeks.

Significant increases in MPOD were evident in the 20 mg lutein group and combined lutein/zeaxanthin group at 48 weeks. A trend towards improved best-corrected visual acuity and significantly enhanced contrast sensitivity (p < 0.05) was also observed when comparing the 20 mg lutein group with the placebo group at 48 weeks.

The authors concluded that lutein and zeaxanthin supplementation in early AMD appears to play a causative role in enhancing visual function and may alter the progression of the disease.

Arch Ophthalmol 2012; 119: 11: 2290-2297.

Long-term effects of vitamins C and E, ß-carotene and zinc on AMD

Report Number 35 from the Age-Related Eye Disease Study (AREDS) Group has described the long-term (10-year) effect of the AREDS supplement formulation, consisting of high-dose antioxidants and zinc, on the progression of age-related macular degeneration (AMD).

AREDS, a multi-centre, randomised clinical trial originally involved 4,757 participants with varying severity of AMD; 3,549 surviving participants consented to follow-up at 10 years. Participants had been randomly assigned to treatment (antioxidants C, E and ß-carotene and/or zinc) versus placebo during the clinical trial.

Compared with the participants originally assigned to placebo, those given the AREDS formulation showed a significant odds reduction in the risk of developing advanced AMD or the development of neovascularisation (NV) with the AREDS formula at 10 years (odds ratio [OR] 0.66, 99% confidence interval [CI] 0.53-0.83 and OR 0.60, CI 0.47-0.78, respectively). No significant (p = 0.93) reduction in risk was evident for central geographic atrophy (CGA). No adverse effects were associated with the AREDS formulation.

It was concluded that the beneficial effects of the AREDS formula persisted for development of NV AMD, but not for GCA, five years after the end of the clinical trial. These findings are consistent with the recommendation that patients with intermediate or advanced AMD in one eye should consider taking the AREDS formula.

Ophthalmology; Epub ahead of print 11 April 2013.

Continued page 16

Abstracts

From page 15

Why do adults use dietary supplements?

Dietary supplements are used by more than half of adults; most of these products are available without prescription, that is, 'over-the-counter' for self-directed use.

This study examined the motivations for dietary supplement use in adults in the United States. A total of 11,956 adults (20 years or older) were examined in the National Health and Nutrition Examination Survey from 2007 to 2010; this is a nationally representative, cross-sectional, population-based survey.

The most commonly reported reasons for taking oral supplements were to 'improve' (45 per cent) or 'maintain' (33 per cent) overall health. Women were most likely to use calcium products for 'bone health' (36 per cent), whereas men were most likely to indicate using supplements for 'heart health or to lower cholesterol' (18 per cent). Older adults (60 years or older) were more likely to report organ-specific reasons, such as heart, bone or eye health.

Notably, less than one-quarter of the products were used as the result of recommendations by a health-care provider.

JAMA Intern Med 2013; 173: 5: 355-361.

Unilateral mydriasis associated with ocular contact with a supplement powder

This case report describes the unique presentation of a pharmacological-induced unilateral mydriasis in a healthy, young female following exposure to an energy supplement.

A 20-year-old active-duty Marine presented to an emergency department for evaluation with regard to a unilateral enlarged pupil. She had no visual deficits or other symptoms. She was aware of having consumed an energy drink including a supplement powder mix and recalled rubbing her eye while pouring the mix that morning. Clinical examination revealed a right dilated pupil; the affected pupil was unreactive to light both directly and consensually, with normal left pupil findings. Ocular examination was otherwise unremarkable.

Following a lack of responsiveness to pilocarpine challenge, pharmacological dilation was diagnosed, potentially secondary to contact of the eye with the nutritional supplement. Two days after the initial presentation, right pupil responses had returned to normal.

Supplement mixes may contain compounds with stimulant activity that can mimic pharmacologic agents that are used for pupil dilation. This presentation highlights the importance of taking extensive histories in military populations that may present with ocular presentations.

Mil Med 2012; 177: 3: 359-360.

Dietary lactoferrin alleviates age-related lacrimal dysfunction in mouse

With age, there is a decrease in lacrimal gland secretory function; this effect is thought to contribute to the increased prevalence of dry eye disease in older populations. Lactoferrin, the primary glycoprotein component of tears, is recognised to have multiple functions including anti-inflammatory effects and the promotion of cell growth.

In this study, 12-month-old mice (n = 20) were randomly divided into either a control group or an oral lactoferrin treatment group. Tear function was measured after six months. The lacrimal glands were subject to histological examination. Monocyte chemotatic protein-1 (MCP-1) and tumour necrosis factor-alpha (TNF-α) gene expression levels were measured by real-time PCR.

Tear secretion was greater in the treated group than in controls. Lactoferrin administration was also found to significantly reduce inflammatory cell infiltration and the MCP-1 and TNF-α expression levels.

These findings were reported to indicate that oral lactoferrin preserves lacrimal gland function in aged mice by attenuating oxidative damage and suppressing gland inflammation. The authors indicated that this experimental evidence lays a foundation for investigation into the potential of oral lactoferrin as a possible therapy for dry eye disease.

PLoS One 2012; 7: 3: e33148.

Yellow corneal ring associated with vitamin supplementation for AMD

This retrospective, single-centre case series reports the first described instances of peripheral yellow corneal rings secondary to vitamin supplementation for age-related macular degeneration (AMD).

This report describes the eyes of four patients taking vitamin supplements for AMD with circumferential, yellow peripheral corneal rings. The patients also exhibited subtle yellowing of the skin that was most notable on the palms. Serum carotene levels were normal in two of the three patients and markedly elevated in one patient.

The authors concluded that it was unclear how to counsel patients with regard to the ocular finding. It was suggested that a formal study be performed on patients taking vitamin supplements for AMD to specifically screen for the corneal rings and to measure serum carotene levels at the time of their identification.

Ophthalmology 2012; 119: 5: 1011-1016.

A fish scale-derived collagen matrix as an artificial cornea in rats

This study investigated the potential for a fish scale-derived collagen matrix (FSCM) to act as an artificial cornea.

Light scatter (determined with a stray-light measuring device) and light transmission (measured using a broadband absorption spectrometer) of the FSCM were measured and compared to human cornea. Short-term (21-day) biocompatibility was tested in a rat model through implantation of the device either using anterior lamellar keratoplasty (ALK), inter-lamellar corneal pocket (IL) or sub-conjunctivally (SC).

It was found that the amount of light scatter with the FSCM was comparable to that seen in early cataract and the percentage of light transmission was similar to that evident with a physiologic human cornea. The best outcome with regard to biocompatibility was observed with ALK; histological assessment was described to show a chronic inflammation varying from mild and moderate in the ALK- and IL-groups, to severe in the SC-group.

The use of FSCM for ALK was described to be feasible, despite technical difficulties with the physiologic tolerance of the implant. The authors indicated that the light scatter and transmission data show that the first version of the FSCM is similar to human corneal tissue in respect to its optical properties; further studies are needed to more clearly understand its immunogenicity.

Invest Ophthalmol Vis Sci 2013; Apr 11: Epub ahead of print. ■

Administration of anti-VEGF for treatment of macular degeneration

A step by step guide to the procedure for using injectable drugs to combat choroidal neovascularisation.

History of wAMD

Wet age-related macular degeneration (wAMD) is the predominant condition responsible for visual impairment in individuals over the age of 55 years in the developed world.[1] Prior to the availability of anti-VEGF (vascular endothelial growth factor) agents, laser photocoagulation and photodynamic therapy (PDT) with Visudyne were used predominantly to treat wAMD.

Laser treatment slowed the progression of the disease but it did not restore vision loss and was associated with a high rate of recurrence.[2,3]

PDT is a two-step process combining intravenous infusion of a light-activated drug (Visudyne) with the light from a non-thermal laser. The laser is directed onto the retinal area to seal or slow the growth of abnormal retinal blood vessels. Although PDT treatment slows the loss of vision in the first six months, it does not prevent vision loss.[2]

Since the listing of Lucentis on the Pharmaceutical Benefits Scheme in 2007, the use of anti-VEGFs has revolutionised the management of wAMD. A second anti-VEGF, Eylea, has recently been listed on the Pharmaceutical Benefits Scheme.

Early diagnosis of wAMD and prompt initiation of anti-VEGF therapy are pivotal for the best patient outcome.[2] Sudden changes in vision or impairment should be brought to the attention of an eye specialist immediately. When left untreated, wAMD progresses rapidly.[1] Treatment in less than one month of onset of symptoms results in better VA outcomes.[4] Between regular eye tests and macular checks, the Amsler grid is a simple and essential tool for self-monitoring for possible symptoms of wAMD.[2]

Anti-VEGF treatment

Anti-VEGF treatments are administered by intravitreal injection and are performed by a qualified ophthalmologist experienced in the procedure.[5,6] The injection is performed in the clinic as a day procedure and usually under local anaesthetic.[7]

The patient may be instructed to administer broad-spectrum antimicrobial eye-drops to the affected eye four times daily for three days prior to treatment.[8] On arrival to the clinic, examinations are performed to assess wAMD disease state. If treatment is required, the patient is prepared for the procedure and the injection is administered. A step-by-step guide for the injection procedure is shown in the Figure (page 18). The procedure outlined below is generic and subtle differences may exist between different treatment options.

Pre-injection medical examination

When the patient arrives at the clinic for their injection, they will have a number of examinations performed by the ophthalmologist to assess wAMD disease state, including optical coherence tomography, fluorescein angiogram and VA measurement. The patient's medical history is also recorded and evaluated.[5] Other relevant information including clinical findings from the optometrist is also considered.

Pre-injection preparation

The injection procedure should be performed aseptically, including use of surgical hand disinfection and sterile surgical gloves.[5,6] Adequate anaesthesia and a broad spectrum topical microbicide are administered prior to the injection using eye-drops.[5]

The periocular skin, eyelid, eyelashes and ocular surface are disinfected with povidone iodine solution 10% and a sterile ophthalmic drape is placed over the eye. A sterile lid speculum is inserted into the eye. Povidone iodine ophthalmic solution (5%) is applied to the eye for 90 seconds and then rinsed with ophthalmic saline solution.[9]

Injection procedure

Once the doctor has prepared the eye for the injection, the patient is directed to look away from the injection site. The treatment is administered via the sclera, 3.5 mm to 4.0 mm posterior to the limbus, avoiding the horizontal meridian and aiming toward the centre of the globe.[5] The injection volume is slowly delivered and the needle is slowly removed. One eye only may be injected on each occasion.

Patient follow-up post-injection

Immediately post-injection, the patient is evaluated for light perception, indirect ophthalmoscope findings and intraocular pressure. The patient should make a follow-up appointment and be instructed to administer broad-spectrum antimicrobial eye-drops to the treated eye for three to five days after treatment to prevent any possible eye infection.[6,8] Any side-effects should be reported immediately and monitoring by the doctor is recommended.[5]

Post-injection monitoring and subsequent injections

Patients with wAMD should be evaluated regularly to assess the requirement for further injections. For subsequent injections, the scleral site for intravitreal injections should be rotated so that the same site is not injected repeatedly.[5]

Potential side-effects of anti-VEGF injections

Symptoms of potential side-effects should be explained by the doctor and the patient should be given a copy of the consumer medicine information document.[7,8] For a comprehensive guide to possible side-effects with intravitreal therapies, refer to product information.[5,6]

Anti-VEGF therapy is essential for the treatment of wAMD. Early referral and prompt initiation of treatment is pivotal for the best patient outcome. Compliance with ongoing treatment and follow-up is vital to maintain visual outcomes.

Continued page 18

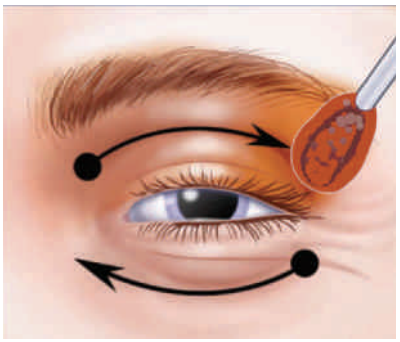
This article was prepared by Novartis Pharmaceuticals Australia Pty Ltd

Administration of anti-VEGF for treatment of macular degeneration

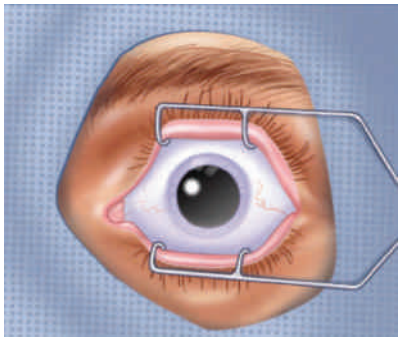
From page 17

1. Sivaprasad S, Hykin P. What is new in the management of wet age-related macular degeneration? *British Medical Bulletin* 2013; 1-11.
2. Macular Degeneration Foundation, Macular Degeneration booklet, October 2012. www.mdfoundation.com.au. Accessed 10.04.2013.
3. Lim LS et al. Age-related macular degeneration. *The Lancet* 2012; 379: 1728-1738.
4. Rauch R et al. The significance of early treatment of exudative age-related macular degeneration. *Retina* 2012; 32: 1260-1264.
5. Lucentis approved product information, October 2012.
6. Eylea approved product information, March 2012.
7. Eylea approved consumer medicine information, February 2013.
8. Lucentis approved consumer medicine information, October 2011.
9. Aiello LP et al. Evolving guidelines for intravitreous injections. *Retina* 2004; 24: S3-S19.

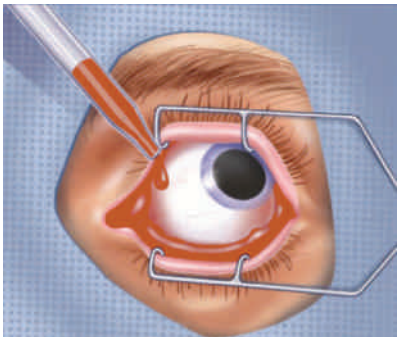
1. Dilate the pupil.
2. Apply topical anaesthesia and administer broad-spectrum antimicrobial eye-drops



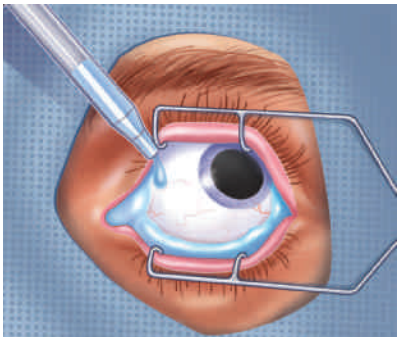
3. Apply 10% povidone iodine solution to periocular skin, lids and eyelashes and place sterile drape over eye



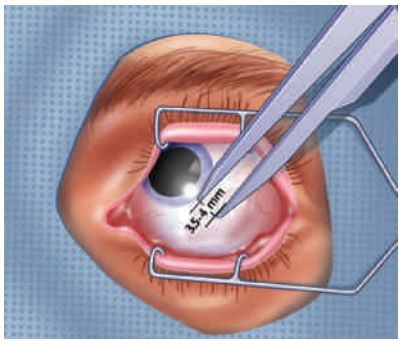
4. Apply sterile lid speculum



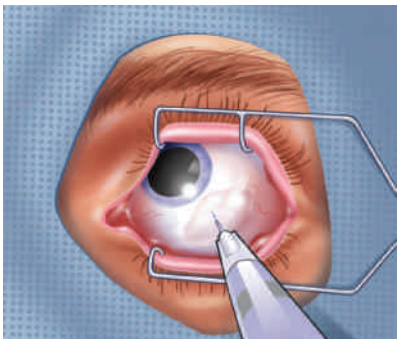
5. Instil 5% povidone-iodine eye-drops and wait for 90 seconds



6. Rinse the eye with ophthalmic saline solution



7. Direct the patient to look away from the injection site. Mark an injection site at an area 3.5 mm to 4.0 mm posterior to the limbus, avoiding the horizontal meridian and aiming toward the centre of the globe.



8. Slowly deliver the injection volume, then remove the needle slowly. Rotate the scleral site for subsequent intravitreal injections so that the same site is not injected repeatedly.

9. Administer broad-spectrum antimicrobial eye-drops

Experience* that can't be overlooked.[1–23]

*With more than 10 years of experience worldwide, Lucentis® has a well-established efficacy and safety profile.[1–23] Since 2000,[1] it has been studied in more than 10 prospective, multicentre trials in more than 5,500 patients.[1–23]

LUCENTIS®
RANIBIZUMAB

PBS Information: Authority Required. Refer to PBS Schedule for full Authority Required Information for wet AMD. Lucentis is not PBS listed for DME and RVO.

See approved Product Information before prescribing. Approved Product Information available on request. For the most up-to-date Product Information, go to www.novartis.com.au/products_healthcare.html.*Please note product changes in italics.

Lucentis® (ranibizumab [rbe]). Indication: Treatment of neovascular (wet) age-related macular degeneration (AMD). *Treatment of visual impairment due to diabetic macular oedema (DME). Treatment of visual impairment due to macular oedema secondary to retinal vein occlusion (RVO).* **Dosage and administration:** Complex dosage and administration – see full PI before prescribing. **Contraindications:** Hypersensitivity to product components, active or suspected ocular or periocular infections active intraocular inflammation. **Precautions:** Intravitreal injections have been associated with endophthalmitis, intraocular inflammation, rhegmatogenous retinal detachment, retinal tear, iatrogenic traumatic cataract and increased intraocular pressure. Proper aseptic injection techniques must be used. *Review* patients during the week following injection to permit early treatment if an infection occurs. *Transient increases in intraocular pressure (IOP) have been seen within 60 minutes of injection of Lucentis. Sustained IOP increases have also been reported.* Intraocular pressure and perfusion of the optic nerve head must be monitored and managed appropriately. *Patients should be reviewed for IOP rise pre-injection and 60 minutes post-injection.* Safety and efficacy of administration to both eyes concurrently have not been studied. There is a potential risk of arterial thromboembolic events following intravitreal use of VEGF inhibitors. A numerically higher stroke rate was observed in patients treated with ranibizumab 0.5mg compared to ranibizumab 0.3mg or control, however, the differences were not statistically significant. Patients with known risk factors for stroke, including history of prior stroke or transient ischaemic attack, should be carefully evaluated by their physicians as to whether Lucentis treatment is appropriate and the benefit outweighs the potential risk. As with all therapeutic proteins, there is a potential for immunogenicity with Lucentis. Lucentis has not been studied in patients with concurrent eye conditions such as retinal detachment or macular hole. No formal interaction studies have been performed. *Limited experience with treatment of patients with prior episodes of RVO and of patients with ischemic branch RVO (BRVO) and central RVO (CRVO). In patients with RVO presenting with clinical signs of irreversible ischemic visual function loss, treatment is not recommended. Should be used with caution in women of child bearing potential in general, and during pregnancy in particular. For women who wish to become pregnant and have been treated with ranibizumab, it is recommended to wait at least 3 months after the last dose of ranibizumab before conceiving a child*; use of effective contraception recommended for women of childbearing potential; breastfeeding not recommended. Patients who experience temporary visual disturbances following treatment must not drive or use machines until these subside. **Adverse effects:** Very common: Intraocular inflammation, vitritis, vitreous detachment, retinal haemorrhage, visual disturbance, eye pain, vitreous floaters, conjunctival haemorrhage, eye irritation, foreign body sensation in eyes, lacrimation increased, blepharitis, dry eye, ocular hyperaemia, eye pruritus, intraocular pressure increased, nasopharyngitis, headache, arthralgia. Common: Retinal degeneration, retinal disorder, retinal detachment, retinal tear, detachment of the retinal pigment epithelium, retinal pigment epithelium tear, visual acuity reduced, vitreous haemorrhage, vitreous disorder, uveitis, iritis, iridocyclitis, cataract, cataract subcapsular, posterior capsule opacification, punctuate keratitis, corneal abrasion, anterior chamber flare, vision blurred, injection site haemorrhage, eye haemorrhage, conjunctivitis, conjunctivitis allergic, eye discharge, photopsia, photophobia, ocular discomfort, eyelid edema, eyelid pain, conjunctival hyperaemia, stroke, influenza, urinary tract infection*, anaemia, anxiety, cough, nausea, allergic reactions (rash, pruritus, urticaria, erythema). Uncommon: Blindness, endophthalmitis, hypopyon, hyphaema, keratopathy, iris adhesions, corneal deposits, corneal oedema, corneal striae, injection site pain, injection site irritation, abnormal sensation in eye, eyelid irritation. Serious adverse events related to intravitreal injections include endophthalmitis, rhegmatogenous retinal detachment, retinal tear and iatrogenic traumatic cataract. **observed only in the DME population.* (luc251011m.doc).

References: 1. Rosenfeld PJ *et al. Ophthalmology* 2005; 112: 1048–53. 2. Rosenfeld PJ *et al. N Engl J Med* 2006; 355: 1419–31. 3. Brown DM *et al. Ophthalmology* 2009; 116: 57–65. 4. Schmidt-Erfurth U *et al. Ophthalmology* 2011; 118: 831–9. 5. Singer MA *et al. Ophthalmology* 2012; 119(6): 1175–83. 6. Boyer DS *et al. Ophthalmology* 2009; 116: 1731–9. 7. Bhisitkul RB *et al. Invest Ophthalmol Vis Sci* 2012; 53: E-Abstract 3679. 8. Regillo CD *et al. Am J Ophthalmol* 2008; 145: 239–48. 9. Holz FG *et al. Ophthalmology* 2011; 118: 663–71. 10. The CATT Research Group *et al. N Engl J Med* 2011; 364: 1897–908. 11. Antoszyk AN *et al. Am J Ophthalmol* 2008; 145: 862–74. 12. Abraham P *et al. Am J Ophthalmol* 2010; 150: 315–24. 13. Rosenfeld PJ *et al. Ophthalmology* 2006; 113: 623–32. 14. Heier JS *et al. Ophthalmology* 2006; 113: 633–42. 15. Patel RD *et al. Semin Ophthalmol* 2011; 26(6): 372–9. 16. Shona O *et al. Clin Experiment Ophthalmol* 2011; 39(1): 5–8. 17. Mitchell P *et al. Br J Ophthalmol* 2010; 94: 2–13. 18. Approved Product Information for LUCENTIS® 2012. 19. Clinicaltrials.gov. Available at clinicaltrials.gov/ct2/results?term=ranibizumab+and+australia. Accessed 9 November 2012. 20. Chang TS *et al. Arch Ophthalmol* 2007; 125: 1460–9. 21. Schmidt-Erfurth U. *Expert Opin Drug Saf* 2010; 9: 149–65. 22. LUMINOUS study. Available at clinicaltrials.gov/ct2/show/NCT01318941. Accessed 9 November 2012. 23. Lalwani GA *et al. Am J Ophthalmol* 2009; 148: 43–58. Novartis Pharmaceuticals Australia Pty Limited, ABN 18 004 244 160. 54 Waterloo Road, North Ryde NSW 2113. Ph (02) 9805 3555. ® Registered Trademark. LUC0941. NOLU7197. March 2013.

NOVARTIS

Linezolid-induced toxic optic neuropathy

Neurological complications, although rare, can result from long-term use of linezolid. In this case report, a patient experienced a disruption in vision after just two doses.

Amanda J Korth
Pacific University College of Optometry, Forest Grove OR
Dr Leonid Skorin Jr
OD DO MS FAAO FAOCO
Mayo Clinic Health System
Albert Lea MN

Zyvox (linezolid) is an oxazolidinone (monoamine oxidase inhibitor) antibiotic used primarily in treatment of antibiotic resistant gram-positive infections.[1] Typically, it is used in the treatment of vancomycin-resistant enterococcus and methicillin-resistant *Staphylococcus aureus* infections.[2] Recently, it has been used more often for other gram-positive pathogens.[3] Toxic optic neuropathy has been associated with long-term use of linezolid. On rare occasions, it has been associated with neurologic toxicity after short-term dosing. In this case report, mild optic neuropathy developed after two doses of linezolid in our patient.

A 30-year-old white female presented to the emergency department with fever and bilateral breast pain, secondary to severe lactational mastitis. The mastitis infection had begun two weeks earlier. She had been unresponsive to earlier therapy with both oral cephalexin and oral dicloxacillin antibiotics. Her condition worsened and she was admitted to the hospital.

She was then started on intravenous linezolid every 12 hours. After the second dose of linezolid, the patient developed an allergic reaction which manifested as a rash on her torso. She also reported a disruption in her vision at this time. The intravenous linezolid was discontinued prior to her third dose.

Case report

The patient reported she had trouble focusing and her eyes felt 'heavy' after her second dose of linezolid. Her corrected vision was 6/6 in both OD and OS. Slit-lamp findings were unremarkable and the patient's intraocular pressure was normal.

The patient's fundus examination showed some mild temporal pallor with thinning of her optic nerve OD. Her red saturation test was normal OD compared to OS. There was a possible 0.3 log unit Marcus Gunn pupil OD. This was difficult to decipher given the large amount of hippus apparent in both eyes. Her right pupil was slightly larger than her left but reaction to light was equal in the two eyes. Her colour vision and stereopsis were both normal. There were no defects

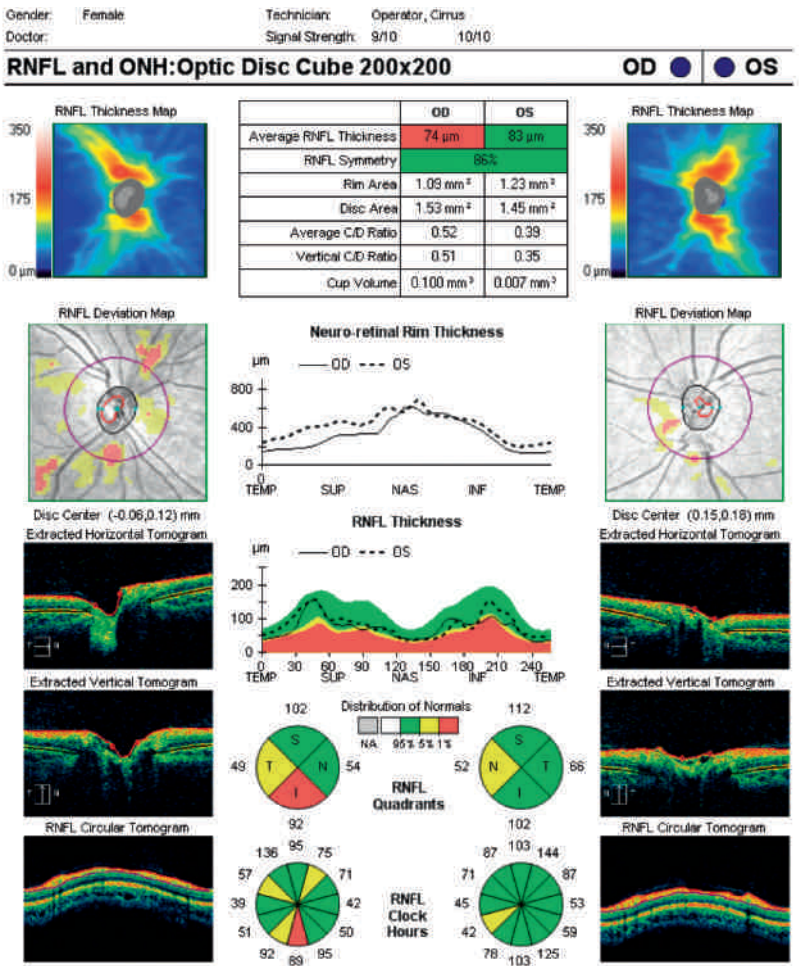


Figure 1. OCT results from first visit

found on her visual field. There was thinning noted on her optical coherence tomography (OCT) inferiorly with some early changes noted in the temporal quadrant OD and nasal quadrant OS (Figure 1).

The patient reported one month later for repeat ocular testing. She reported that her previous vision changes were relatively stable and some visual adaptations had taken place. There were no changes to her red saturation, stereopsis, pupils and colour vision. There was increased thinning seen on the OCT report (Figure 2). There was now a nasal quadrant defect accompanying the previous temporal and inferior depression OD. A persistent mild nasal depression was noted OS.

Discussion

Linezolid has been associated with multiple neurological complications. These complications are rare.[4] Neurotoxic complications, including toxic optic neuropathy, are generally associated with linezolid use of greater than 28 days.[1-3] Commonly, toxic optic neuropathy presents with acute vision loss, visual field scotomas and impaired colour vision.[5] A majority of blindness from this medication occurs after 10 months of use.[6] Blindness is generally associated when the patient has a pre-existing optic nerve disorder.[6]

The mechanism of linezolid-induced neurotoxicity is thought to be due to inhibition of protein synthesis.[3] This mechanism has evidence to support it with long-term exposure, but not usually as an acute event.[1] Tissues that have a high dependence on the oxidative phosphorylation pathway such as the optic nerve are more susceptible to damage if this synthesis is interrupted.[1,3] Given the high dependence on ATP (adenosine triphosphate) reserves, this puts the optic nerve at risk for the greatest potential involvement.[1] Also in this category are the brain, retina, skeletal muscles and kidneys.[1]

Linezolid has a high level of central nervous system and intraocular penetration which increases the chance for toxic neuropathy.[2] Risk factors for linezolid-induced neurotoxicity include length of treatment, pre-existing optic nerve damage and pre-existing systemic conditions.[3,4] Diabetes, alcoholism, chemotherapy treatment and antiretroviral therapy have all been found to increase risk of developing neurotoxicity.[3] Our patient did not have any of the factors to increase her risk for developing this optic neuropathy.

Our patient had no history of previous optic nerve damage. Given the subtle presentation of the thinning under fundus examination, it does not rule out the possibility of a pre-existing condition. One previous published case reported toxicity after 16 days of linezolid use in a young female with no pre-existing optic nerve disease.[2] This patient also had muscular dystrophy but the authors felt it did not play a factor in the optic neuropathy.[2] Another published case showed a patient who had encephalopathy secondary to linezolid treatment after 36 hours of exposure to the drug.[3] These cases demonstrate the possibility of neurological complications even with the standard dosing schedule for linezolid.

It is not unusual for the optic neuropathy to improve after linezolid therapy is discontinued.[2] Our patient's neuropathy did not improve after stopping the drug. Her OCT showed mild progressive thinning of the optic nerve OD, though her subjective symptoms had stabilised.

It is now recommended that prior to starting a patient on linezolid, a baseline ophthalmic examination should be performed.[5] This is challenging, because this antibiotic is currently given in acute care, intensive care or emergency department settings for serious, often life-threatening infections. If the baseline examination is conducted, it should include a complete eye exam, visual field and colour vision evaluation.

We would recommend adding a spectral OCT to assist in detecting mild neurotoxic changes to the optic nerve such as those seen in our patient. ■

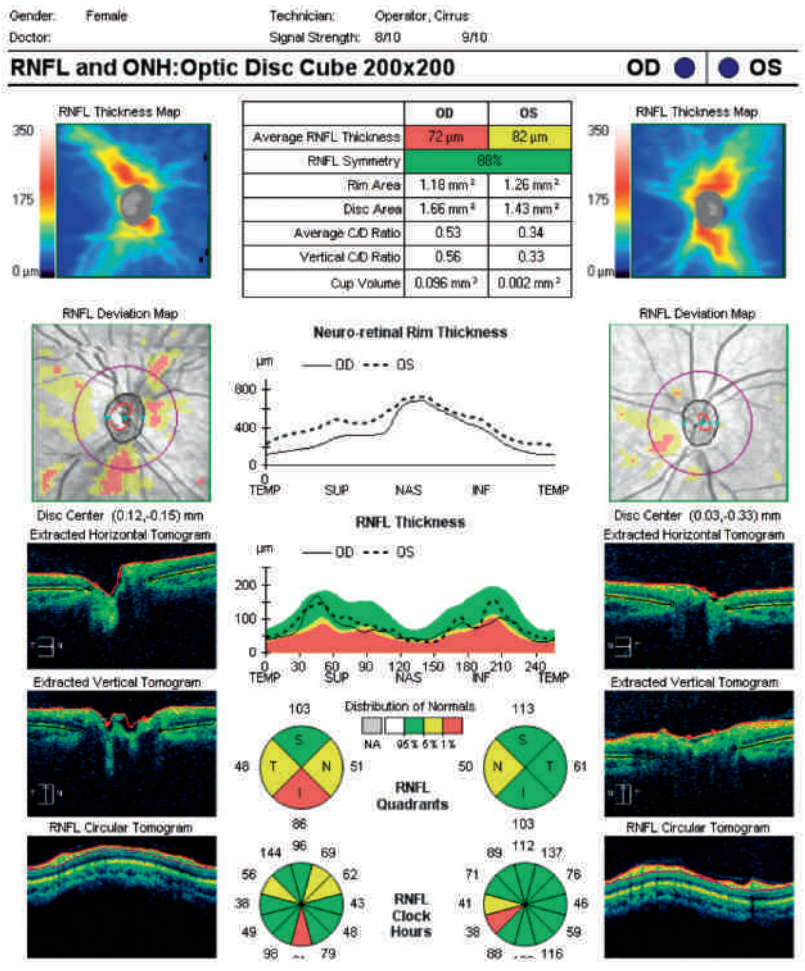


Figure 2. OCT results from second visit

1. DeVriese A, Van Coster R, et al. Linezolid-induced inhibition of mitochondrial protein synthesis. *Clinical Infectious Diseases* 2006; 42: 1111-1117.
2. Azamfirei L, Copotoiu S et al. Complete blindness after optic neuropathy induced by short-term linezolid treatment in a patient suffering from muscular dystrophy. *Pharmacoepidemiology and Drug Safety* 2007; 16: 402-404.
3. Aykroyd L, Curtis J et al. Early onset probable linezolid-induced encephalopathy. *J Neurol* 2010; 247: 433-435.
4. Rucker J, Hamilton S et al. Linezolid-associated toxic optic neuropathy. *Neurology* 2006; 66: 595-598.
5. Lee E, Burger S et al. Linezolid-associated toxic optic neuropathy: a report of 2 cases. *Clinical Infectious Diseases* 2003; 37: 1389-1391.
6. Brown J, Aitken S, van Manen R. Potential for linezolid-related blindness: A review of Spontaneous Adverse Event Reports. *Pharmacotherapy* 2011; 31: 6: 585-590.

Initiating treatment for primary open angle glaucoma

Dr Diane L Webster
MBBS FRACS FRANZCO
Consultant Ophthalmologist, Royal Victorian Eye and Ear Hospital
Adjunct Senior Lecturer, Medical and Health Professional Education and Educational Research (Health PEER) Unit, Monash University

Selective laser trabeculoplasty (SLT) should be considered as first line therapy for primary open angle glaucoma (POAG) as an alternative to topical prostaglandin analogue eye-drops. Clinical trials have demonstrated both treatment modalities to be equally effective in lowering intraocular pressure (IOP).[1,2]

Selective laser trabeculoplasty

SLT effectively lowers IOP by photocoagulation of the trabecular meshwork. The precise mechanism of action is not known but enhanced cellular activity and release of chemical mediators in the meshwork is believed to occur.[3,4] This results in repopulation of trabecular cells, which is thought to improve outflow.[5] The recommended SLT technique is the application of approximately 50 non-overlapping laser spots to 180 degrees of the trabecular meshwork in each eye[1] (Figure 1). The laser energy is adjusted to create a 'champagne bubble' or blanching at each spot. The second 180 degrees in each eye is usually treated one week later.

Studies have shown 360 degrees of laser treatment to be more effective than 180 degrees.[2] This is not done at one sitting, to avoid the risk of a post-laser pressure rise.[1] In contrast to the situation following laser capsulotomy or iridotomy, the patient rarely requires topical steroids after SLT. There is some evidence that routine use of these agents may reduce the therapeutic response to the laser.[6] Steroids drops, such as gutte flourometholone 0.1% (FML) three times a day for three days, may be useful in the occasional patient with a persistent red and gritty eye due to excessive post-laser inflammation.

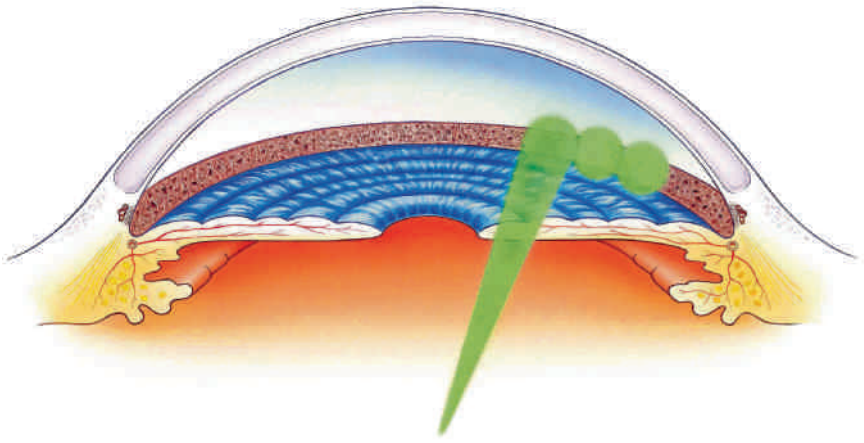


Figure 1. Selective laser trabeculoplasty, Q-switched, frequency-doubled Nd: YAG laser (532 nm) applied to the trabecular meshwork Source: Ellex Medical Pty Ltd

Prostaglandin analogues

The commonly prescribed prostaglandin analogues are latanoprost (Xalatan), bimatoprost (Lumigan) and travoprost (Travatan). The dose of each is one drop daily. These agents lower intraocular pressure by improving uveoscleral outflow[7] and are more effective over a 24-hour period when instilled at night.[8]

Xalatan is very well tolerated but should be kept refrigerated in warm climates if the daily temperature is above 25°C, whereas Lumigan does not need to be refrigerated. Travatan now comes with a benzalkonium chloride (BAK)-free preservative, which may be advantageous for dry eye patients or those with BAK sensitivity (Table 1).

Advantages of SLT

SLT can be performed as an office consultation, as it is relatively painless[9] and is no more uncomfortable for the patient than gonioscopy and applanation tonometry. The main requirement is that the patient should be able to remain still for the time it takes the ophthalmologist to perform the procedure using a Goldmann gonioscopy contact lens. SLT generally maintains its effect on IOP for between two and 15 years (average six years) and may be repeated if necessary.[10]

There is some evidence that SLT is equally as effective as topical prostaglandin analogues[11] and avoids the necessity for ongoing daily eye-drops. This is advantageous to many patients, including those with poor vision, cognitive impairment or reduced manual dexterity from conditions such as arthritis. Patients may become non-compliant, non-adherent and non-persistent leading to further field loss.[12]

SLT may also be the preferred treatment option for patients with dry eyes or ocular surface disorders as it avoids the side-effects or sensitivity to eye-drops.[13]

There is also a significant cost benefit to the patient, as it has been estimated that the individual expenditure on glaucoma drops over a five-year period is $8,524.[14,15] The Medicare (MBS) schedule fee for each SLT is $451; a total of four treatments costs $1,804, of which 85 per cent is reimbursed

Consider a switch to selective laser trabeculoplasty if patients develop eye-drop allergies or are poorly adherent to their topical medications.

Generic name	Brand name	Dose
Latanoprost	Xalatan	1 drop nocte OU
Bimatoprost	Lumigan	1 drop nocte OU
Travaprost	Travatan	1 drop nocte OU

Table 1. Prostaglandin analogues available in Australia

Patient	SLT	Prostaglandin drops
Forgetful, poor adherence	Yes	No
Difficult/unable to examine on slitlamp	No	Yes
Dry eyes/preservative allergies	Yes	No
Access to SLT laser	Yes	No
Arthritis of hands or dependence on others to instil drops	Yes	No

Table 2. Patients suitability for SLT or topical medications as first line

by Medicare. SLT controls IOP for an average of six years[15] making it highly cost-effective compared to eye-drops.

Advantages of prostaglandin analogues

These agents are a simple, effective treatment for glaucoma and it may be more convenient to write a script for eye-drops rather than refer them to an ophthalmological colleague for SLT. Eye-drops may be a better option for patients who are difficult to examine on the slitlamp, perhaps due to obesity or immobility of the spine, or if they have trouble staying still for gonioscopy or applanation tonometry.

Some patients are uncomfortable with the idea of laser treatment or may have had a family member or friend who had a negative experience with laser treatment, even if it was performed for an entirely different condition.

Table 2 outlines which patients are more suitable for SLT or topical medications as first line.

Conclusion

SLT is particularly recommended in the elderly and in patients with dementia, arthritis of the hands, preservative allergies or dry eyes. Some patients may be reluctant to undergo SLT, because they do not appreciate the difference between retinal laser and laser for anterior segment conditions, but this can be explained with the help of a model eye and it may be possible to allay their fears.

Ideally, a close working relationship with a local ophthalmologist who performs SLT should be established, in order to comanage glaucoma patients and confer regarding post-SLT monitoring and management. Prostaglandin analogues may be the preferred option in patients who are difficult to examine on the slitlamp or when there is no access to an ophthalmologist able to perform SLT.

Consider a switch to SLT if patients develop eye-drop allergies or are poorly adherent to their topical medications.

Key messages

- Always consider SLT as first line therapy in POAG patients, particularly those who cannot easily instil eye-drops, have allergies to their topical medications or are poor compliers
- If a decision has been made to use topical medications instead of SLT, prostaglandin analogue eye-drops (Xalatan, Lumigan or Travatan, 1 drop nocte OU) are the agents of choice.
- Collaborate with your local ophthalmologist when initiating treatment for glaucoma cases, as a good working relationship is the key to optimal management of patients with this condition.

Patients wanted for trial

The Centre for Eye Research Australia (CERA) is currently enrolling patients in the Glaucoma Initial Treatment Study (GITS). The study is comparing initial SLT with topical medications. This is a multi-centre trial with principal investigators in all states in Australia. Contact Mario (mariosc@unimelb.edu.au) at CERA if you have a newly diagnosed primary open angle glaucoma patient who would like to take part in the trial. ■

1. Melamed S, BenSimon GJ, Levkovitch-Verbin H. Selective laser trabeculoplasty as primary treatment for open-angle glaucoma: A prospective, nonrandomized pilot study. *Arch Ophthalmol* 2003; 121: 957-960.
2. Lai JSM, Chua JKH, Tham CCY, Lam DSC. Five year follow up of selective laser trabeculoplasty in Chinese eyes. *Clin Exp Ophthalmol* 2004; 32: 4: 368-372.
3. Lanzetta P, Menchini U, Virgilli G. Immediate intraocular pressure response to selective laser trabeculoplasty. *Br J Ophthalmol* 1999; 83: 29-32.
4. Gracner T. Intraocular pressure response to selective laser trabeculoplasty in the treatment of primary open angle glaucoma. *Ophthalmologica* 2001; 215: 267-270.
5. Bylsma SS, Samples JR, Acott TS, Van Buskirk EM. Trabecular cell division after argon laser trabeculoplasty. *Arch Ophthalmol* 1988; 106: 544-547.
6. Realini T. Selective laser trabeculoplasty: A review. *J Glaucoma* 2008; 17: 6: 497-502.
7. Toris CB, Gabelt BT, Kaufman P. Update on the mechanism of action of topical prostaglandins for intraocular pressure reduction. *Surv Ophthalmol* 2008; 53: 6: S107-S120.
8. Toris CB, Zhan G, Camras C et al. Effects of travoprost on aqueous humordynamics in patients with elevated intraocular pressure. *J Glaucoma* 2007; 16: 2: 189-195.
9. Martinez-de-la-Casa JM, Garcia-Feijoo J, Castillo A et al. Selective vs argon laser trabeculoplasty: hypotensive efficacy, anterior chamber inflammation and postoperative pain. *Eye* 2004; 18: 498-502.
10. Hong BK, Winer JC, Shields B et al. Repeat selective laser trabeculoplasty. *J Glaucoma* 2009; 18: 3: 180-183.
11. Nagar M et al. A randomized, prospective study comparing selective laser trabeculoplasty with latanoprost for the control of intraocular pressure in ocular hypertension and open angle glaucoma. *Br J Ophthalmol* 2005; 89: 1413-1417.
12. Nordstrom BL et al. Persistence and adherence with topical glaucoma therapy. *Am J Ophthalmol* 2005; 140: 598-606.
13. Leung EW, Medeiros FA et al. Prevalence of ocular surface disease in glaucoma patients. *J Glaucoma* 2008; 17: 350-355.
14. Cantor LB et al. Economic evaluation of medication, laser trabeculoplasty and filtering surgeries in treating patients with glaucoma in the US. *Curr Med Res Opin* 2008; 24: 2905-2918.
15. Taylor HR. Eye health in the future: what are the challenges for the next twenty years? *Community Eye Health* 2008; 21: 67: 48-49.

Is this geographic atrophy?

The ability to accurately identify and interpret clinical pathologies can have a significant impact on patient care.

Zhichao Wu
BAppSc(Optom)
Macular Research Unit,
Centre for Eye Research Australia,
Department of Ophthalmology,
University of Melbourne

Associate Professor Peter R Keller
BAppSc(Optom) MBA MHEth PhD
Macular Research Unit,
Centre for Eye Research Australia,
Department of Ophthalmology,
University of Melbourne.
Clinical Ocular Imaging Service,
University of Melbourne EyeCare

The use of optical coherence tomography has become indispensable in the diagnosis and management of ocular diseases. With improving technology, spectral domain optical coherence tomography (SD-OCT) can now provide *in vivo*, non-invasive examination of ocular structures with near cellular detail.

A commercially available SD-OCT, the Heidelberg HRA+Spectralis (Heidelberg Engineering, Heidelberg), achieves scanning speeds up to 100 times faster than time domain systems. Combined with confocal scanning laser ophthalmoscopy (cSLO), this device is able to perform eye tracking to compensate for eye movements during examination, allowing for image averaging to reduce noise to produce high resolution images. Eye tracking also enables follow-up scans to be performed with high precision at the same retinal location, enabling detailed examination of progression or response following treatment.

Such high resolution allows the improved discrimination of each retinal layer including the hyper-reflective bands of the outer retina. These three to four bands correspond to the external limiting membrane (ELM), ellipsoids of the inner-segment (ISe), apical processes of the retinal pigment epithelium (RPE) and RPE, Bruch's membrane and potentially the choriocapillaris, respectively.[1] Each band provides a wealth of information, including different pathological characteristics, correlation with visual function and prognostic value.[2,3]

The combined cSLO also performs near-infrared reflectance, allowing improved visualisation of subretinal structures and changes not visible to the naked eye through direct and indirect ophthalmoscopy or fundus lens biomicroscopy. The cSLO also

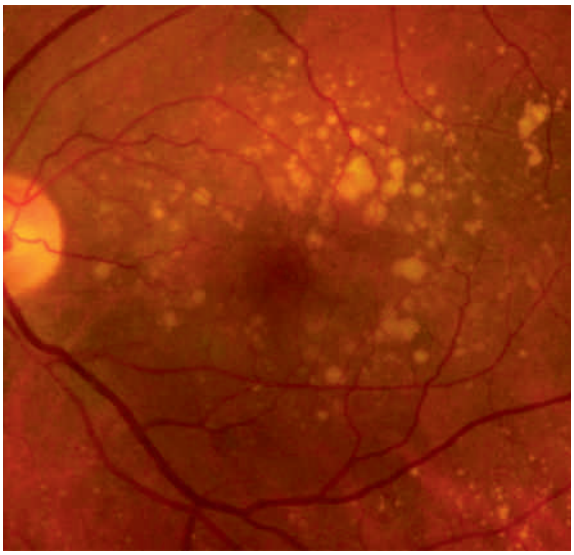


Figure 1. Fundus photograph of patient with early AMD

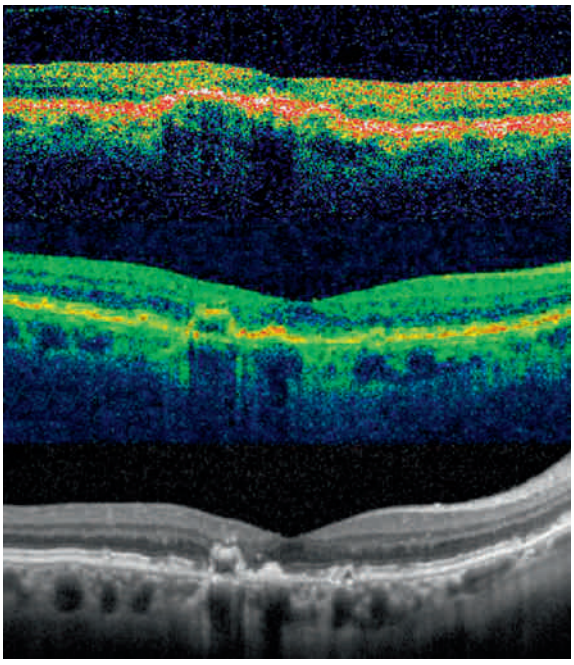


Figure 2. Optical coherence tomography of early AMD using a (top) Stratus OCT (Carl Zeiss Meditec), (middle) Cirrus OCT (Carl Zeiss Meditec) and (bottom) Spectralis HRA+OCT (Heidelberg Engineering, Heidelberg). Increased axial resolution allows delineation of the underlying pathological changes occurring, which is not possible with the lower-resolution devices.

What new imaging technology tells us

performs fundus autofluorescence (FAF) imaging to map the distribution of lipofuscin in the RPE, and other fluorophores in the subretinal space and outer retina.[4] These fluorophores present naturally or as a result of pathology and are not visible on clinical examination. Importantly, they serve to characterise different diseases and are predictive markers of progression.[5,6]

Clinical pathologies

In age-related macular degeneration, the different subtypes can be more accurately distinguished to determine the risk of progression and appropriate management. Signs that confer a high risk of progression to advanced, visually-debilitating disease—including drusenoid pigment epithelial detachments, patches of geographic atrophy and reticular pseudodrusen[7]—are difficult or cannot be determined on clinical examination or by colour fundus photography.

Despite the ability to visualise such detail, the utility of this technology is still limited to the ability of the practitioner to interpret its clinical significance. Although the traditional measure of retinal thickness is useful, interpretation of the underlying pathology is required to identify its significance and to devise an appropriate management plan. Treatment is currently available only for choroidal neovascularisation (CNV), although new treatments, including the nanosecond laser in early AMD patients with high-risk characteristics, are being trialled.

The ability to accurately identify and interpret clinical pathologies can have a significant impact on patient care, which will become increasingly important given the current projections for a significant increase in the demand for specialist medical retinal services to cater for the ageing population.[8]

More efficient pathways in caring for patients with ocular conditions must be explored. Such a pathway being investigated is the Royal Victorian Eye and Ear Hospital Community Eye Care Partnership, and high-resolution advanced retinal imaging technology will be vital in these settings. ■

1. Spaide RF, Curcio CA. Anatomical correlates to the bands seen in the outer retina by optical coherence tomography. Literature Review and Model. *Retina* 2011; 31: 8: 1609-1619.
2. Wong IY, Iu LP, Koizumi H, Lai WW. The inner segment/outer segment junction: what have we learnt so far? *Curr Opin Ophthalmol* 2012; 23: 3: 210.
3. Oishi A, Hata M, Shimozono M, Mandai M, Nishida A, Kurimoto Y. The significance of external limiting membrane status for visual acuity in age-related macular degeneration. *Am J Ophthalmol* 2010; 150: 1: 27-32. e1.
4. Schmitz-Valckenberg S, Holz FG, Bird AC, Spaide RF. Fundus autofluorescence imaging: Review and perspectives. *Retina* 2008; 28: 3: 385-409.
5. Fleckenstein M, Schmitz-Valckenberg S, Martens C, Kosanetzky S, Brinkmann CK, Hageman GS et al. Fundus autofluorescence and spectral-domain optical coherence tomography characteristics in a rapidly progressing form of geographic atrophy. *IOVS* 2011; 52: 6: 3761-3766.
6. Holz FG, Bindewald-Wittich A, Fleckenstein M, Dreyhaupt J, Scholl HPN, Schmitz-Valckenberg S et al. Progression of geographic atrophy and impact of fundus autofluorescence patterns in age-related macular degeneration. *Am J Ophthalmol* 2007; 143: 3: 463-472.
7. Sarks J, Arnold J, Ho I-V, Sarks S, Killingsworth M. Evolution of reticular pseudodrusen. *Br J Ophthalmol* 2011; 95: 7: 979-985.
8. Deloitte Access Economics. Eyes on the future: A clear outlook on Age-related Macular Degeneration. Macular Degeneration Foundation. 2011.

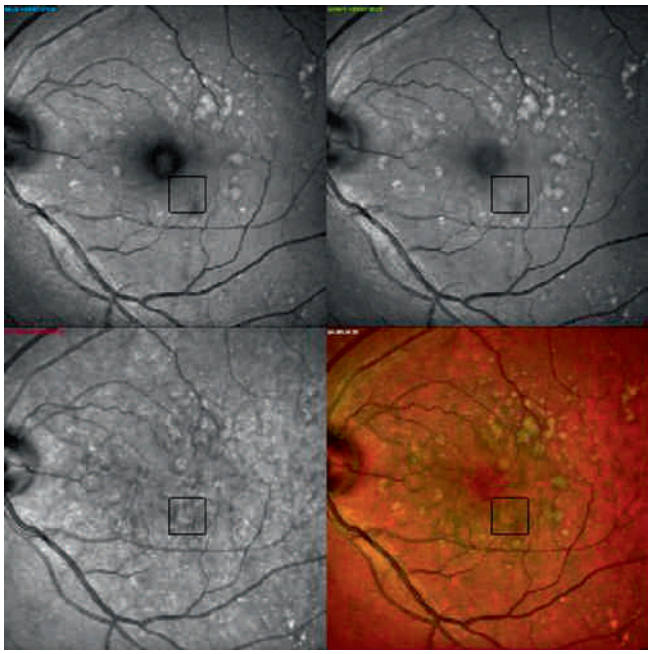


Figure 3. Confocal scanning laser ophthalmoscopy at three wavelengths: (top left) blue, (top right) green, (bottom left) near-infrared and (bottom right) all three wavelengths combined. The highlighted region (square) represents an area of geographic atrophy not visible using the blue and green wavelengths but visible on the infrared reflectance.

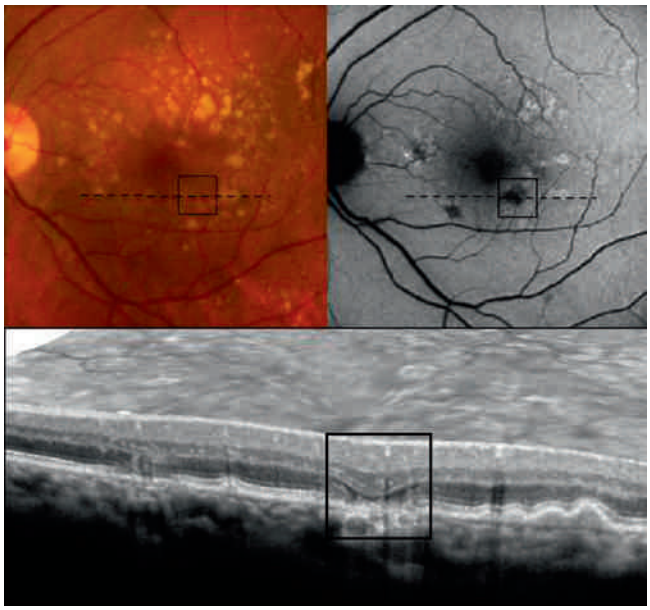


Figure 4. Fundus autofluorescence (top right) reveals loss of lipofuscin within the retinal pigment epithelium (RPE) not visible on colour photography (top left). A line-scan (dashed line) through the area of interest (square) reveals a patch of geographic atrophy on spectral-domain OCT (bottom), characterised by choroidal signal enhancement, loss of RPE and external limiting membrane (ELM) and subsidence of the outer plexiform layer (OPL).

Risk factors call for multidisciplinary management of central serous retinopathy

Angela Hall
BAppSc(Optom)
Australian College of Optometry

Central serous retinopathy (CSR), also known as central serous chorioretinopathy or central serous choroidopathy, is a condition affecting the retina in the macular region. Characterised by a localised serous detachment of the sensory retina, CSR has the potential to lead to severe central vision loss.

There are numerous systemic factors associated with the development of this condition. These systemic associations include emotional stress,[1] hypertension,[2,3] corticosteroid use[3] and hypercortisolism.[4] This condition also appears to have links with both sex and age, and middle-aged men are most commonly affected. It has been shown that CSR has an incidence six times higher in men than women,[5] with the mean age of those developing this condition being 51 years.[6]

The aetiology and pathogenesis of CSR are yet to be completely understood. Research to date concerning the pathogenesis of this condition indicates that this disease is caused by a dysfunction of either retinal pigment epithelium (RPE)[7] or choroid.[8,9]

Many cases of CSR resolve spontaneously without treatment but treatment may be required in more prolonged cases. The prognosis for visual recovery from CSR is often favourable.[10]

Case report

A 64-year-old woman who had recently suffered an episode of nasopharyngitis (common cold) complained of reduced left visual acuity with current spectacles over the previous three weeks. Current medications included sertraline hydrochloride (Zoloft) for the treatment of severe depression and an unknown combination of Chinese herbs used for the treatment of nasopharyngitis.

Visual acuity of the left eye was reduced from 6/6 to 6/9.5-. A 1.50 D hyperopic shift was observed in the left eye. Fundus examination revealed a circular detachment of the sensory retina at the left macula (Figure right). Small precipitates were evident at the superior-temporal margin of the detachment. Optical coherence tomography (OCT) revealed a sensory retinal detachment with an increased macular thickness of 646 µm. Examination of the right eye was unremarkable.

The patient was diagnosed with left CSR. Following consultation with a retinal specialist and ophthalmologist, it was decided that fluorescein angiography was unnecessary and the patient was monitored closely for spontaneous resolution of the detachment.

Nine months after initial presentation, the visual acuity improved to 6/7.5 and the serous retinal detachment had completely resolved. The use of steroidal medication is a known risk factor for the development of CSR, therefore, the patient's general practitioner was advised that future inflammatory disorders should be treated with non-steroidal anti-inflammatory medication where possible. It was also recommended that the use of Chinese herbs be avoided due to possible steroidal properties. The general practitioner was asked to monitor for the presence of hypertension. A three-month review was scheduled to monitor for recurrence and complications.

Discussion

Clinical presentation

Patients with CSR may present with symptoms of sudden unilateral blurred vision, which may occur in conjunction with a positive relative scotoma, dyschromatopsia, micropsia, macropsia, metamorphopsia and/or reduced contrast sensitivity. Patients may be asymptomatic if the central macula is not involved.

Visual acuity is often reduced in this condition. Visual acuity may range from 6/4.8 to 6/240 at onset.[10] The elevated sensory retina can give rise to a hyperopic shift. Vision may be improved with the use of increased plus lenses. Amsler grid assessment might reveal a central or paracentral scotoma and/or metamorphopsia.

Fundus examination in CSR will typically reveal a localised serous detachment of the sensory retina in the macula region. The underlying serous fluid is normally clear. In some cases precipitates can be seen on the posterior surface of the elevated retina. An RPE detachment might be visible, appearing as a small yellow-grey area of elevation within the serous detachment.

Fluorescein angiography may be indicated if the diagnosis is uncertain or if laser treatment is intended. Leakage from the blood retina barrier in CSR can take on an 'ink blot' or 'smoke stack' appearance when observed with fluorescein angiography.

OCT may be used to confirm the diagnosis of this condition. The use of OCT is non-invasive and provides the ability to document the condition over time. OCT may also provide information regarding visual prognosis as fluid persistence on OCT may be correlated with reduced visual recovery.[10] OCT examination may provide both diagnostic and prognostic information in CSR.

Differential diagnosis

There is a number of conditions that can present with signs similar to those of CSR. Differential diagnoses include:

- age-related macular degeneration
- optic disc pit with neurosensory macular retinal detachment
- macular detachment as a result of a rhegmatogenous retinal detachment
- circumscribed choroidal haemangioma
- amelanotic choroidal melanoma
- choroidal neovascularisation.

Pathogenesis

A variety of theories have been proposed regarding the pathogenesis of CSR.[7,8,9] It is believed that the pathogenesis of this condition may be associated with dysfunctions of either the RPE[7] or choroid.[8,9] Spitznas (1986) proposed that damage to RPE cells, from an undefined insult, leads to the secretion of excessive amounts of ions into the photoreceptor layer of the retina, encouraging large quantities of fluid to be pulled into this region. However, in 1994, Guyer and colleagues suggested that it is an increase in permeability of choriocapillaris that leads to dysfunction of the RPE, resulting in neurosensory detachment.[8] Alternatively, in 2005, Tittle and colleagues proposed that choroidal perfusion anomalies may play a role in the pathogenesis of this condition.[9]

Although there are numerous theories that have been proposed to explain the pathogenesis of this condition, many questions remain unanswered and further research in this area is required.

Risk factors

CSR has been found to have a number of associated risk factors including hypercortisolism,[4] psychosocial stress,[1] type A personality[11] and hypertension.[2,3]

Systemic corticosteroids

Corticosteroid use has long been known to have associated ocular complications. The most commonly encountered adverse ocular effects include cataract formation, reactivation of viral infections and glaucoma. CSR is a less common but potentially sight-threatening complication.

There is an increased incidence of CSR associated with endogenous hypercortisolism (Cushing Syndrome)[4] and exogenous corticosteroid use.[3] Corticosteroids administration by mouth,[12] inhalation[13] and epidural[14] has been found to be associated with CSR.

Optometrists should consider advising general practitioners to avoid systemic corticosteroid treatment for patients with a history of CSR. Non-steroidal anti-inflammatory medication may be used as an alternative to corticosteroid treatment in people with a history of this condition. Additionally, all patients being prescribed corticosteroid therapy should be warned to seek optometric or ophthalmic assessment, if they experience any visual changes during or following the therapy.

Some traditional or alternative therapies may contain steroids and therefore have the potential to increase the risk of CSR. The use of alternative therapies is becoming increasingly more prevalent in developed countries. In 2008, The World Health Organization reported that in many developed countries, 70-80 per cent of the population had used some form of alternative medicine.[15]

Steroid components have been isolated in traditional Chinese medicine and the use of these medicines has been linked to the development of Cushing Syndrome.[16] Clinicians should therefore obtain a full drug history from all patients including prescribed, over-the-counter and alternative or traditional therapies.

Psychosocial stress

Emotional stress is commonly acknowledged in ophthalmic texts as a risk factor for the development of CSR. Gelber and Schatz established that 91 per cent of the patients with CSR had experienced a disturbing psychological event that preceded the vision loss by an average of seven days. A further study conducted by Tittl and colleagues demonstrated that patients with CSR are more likely to be using psychopharmacologic medications than those without the disorder.[2] Despite stress being recognised as a possible factor in the aetiology of CSR, stress management is yet to be advocated as an effective treatment.

Type A personality

Type A personality traits have a well-established association with the development of CSR.[11] Personality traits associated with type A behaviour include a competitive drive, a sense of urgency, an aggressive nature and a hostile temperament.[11] Yannuzzi established that 60 per cent of patients with CSR exhibit type A behaviour patterns.[11]

Hypertension

Patients with CSR have been shown to be more likely to have hypertension than those without this ocular condition.[2,3] Interestingly, it has also been discovered that patients with CSR may be predisposed to prehypertension.[17] Patients with CSR should, be monitored regularly for early detection of hypertension and advised of lifestyle modifications that may aid in the prevention of hypertension.

Prognosis

CSR can spontaneously resolve without treatment. The course of the disorder may be short, resolving after one to six months, or prolonged taking up to 12 months to spontaneously resolve.[18] In a smaller proportion of cases the condition may last longer than 12 months.[18] If spontaneous resolution does not occur, treatment may be initiated. Current treatment strategies include Argon laser photocoagulation at the sight of RPE leakage,[19] photodynamic therapy with Verteporfin[20] and intravitreal bevacizumab injections.[21]

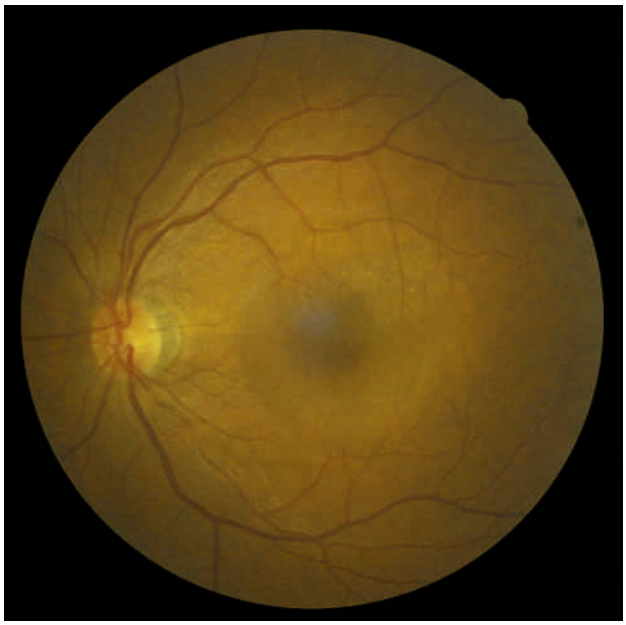
Choroidal neovascularisation can occur secondary to CSR.[22] This is a sight-threatening complication requiring urgent treatment. Photodynamic therapy with vertoporfin has been shown to be safe in the treatment of choroidal neovascularisation associated with CSR.[22]

The prognosis for resolution of the serous detachment and visual recovery for patients with CSR is excellent. The mean acuity following resolution has been shown to be 6/7.5.[10] Both visual acuity at the time of onset and the time to resolution may influence the final visual outcome.[10] Recurrence of CSR is not uncommon, occurring in about one-third of patients with this disorder,[5] so must be monitored closely after resolution.

Conclusion

Clinical examination of patients with CSR must be comprehensive to confirm the diagnosis. OCT may be used as a non-invasive means of confirming the diagnosis of this condition. The case presented illustrates that the use of OCT can eliminate the need for more invasive diagnostic techniques such as fluorescein angiography.

Management of CSR typically involves close monitoring of the condition. There are numerous systemic risk factors that must also be investigated and managed in patients with this condition. The case presented demonstrates that effective management of this condition requires collaboration between the general practitioner, ophthalmologist and optometrist. ■



Left fundus photo illustrating circular sensory retinal detachment at the macula

References are available from j.megahan@optometrists.asn.au, subject: Retinopathy, *Pharma* June 2013.

Antibacterial medical honey Sweet success

Dr Julie Albietz
BAppSc(Hons) PhD
GradCertOcTher
Dr Lee Lenton
MBBS FRANZCO FRACS

Dry eye, tear film and ocular surface conditions are prevalent and often poorly responsive to conventional treatments. They can be recalcitrant and adversely affect quality of life and are potentially vision-threatening.[1] The release of a novel, regulatory approved, ophthalmic product for dry eye and ocular surface disease is therefore welcomed.

Optimel Antibacterial Manuka Eye Drops (Melcare Biomedical Pty Ltd) is a low cost, over-the-counter, sterile, non-preserved, non-cytotoxic, multidose, high efficacy antibacterial honey product.

Optimel is prepared for medical use to a rigorous set of systems and standards from a unique proprietary mix of honeys from the Australian and New Zealand Leptospermum species (commonly known as Manuka, Tea Tree or Jelly Bush), selected for their highest and most consistent level of antibacterial activity, including against antibiotic resistant strains, and other exceptional physicochemical properties.[2-6] Optimel has a three-month shelf life after opening and is an excellent adjunctive treatment for chronic dry eye, meibomianitis and recurrent corneal erosion.

This brief review aims to give clinicians a background in the ophthalmic applications of medical-grade antibacterial honeys, their therapeutic properties and our decade of clinical experience with this unique and impressive natural product.

Background

For thousands of years, the wound-healing and anti-microbial properties of honey have been documented. Natural unprocessed honeys from various floral sources and geographical locations have been used since ancient times to effectively treat a range of ailments including skin wounds, sore throats, gastrointestinal disorders and external eye pathology.[7,8]

Aristotle (350 BC) wrote of honey being a salve for wounds and sore eyes.[9] Celsus, in the first century AD, applied a honey-soaked dressing to prevent symblepharon.[10] Ancient Maya civilisations used honey in the treatment of cataracts.[11] Honey continues to be used in traditional management of ocular infection and inflammation in parts of Africa,[13] the Middle East[13] and Pakistan,[14] and in Indian Ayurvedic medicine.[15] The use of honey in Russian,[16,17] Egyptian[18] and Lebanese[19] ophthalmology for the management of blepharitis, conjunctivitis and infectious and non-infectious keratitis and bullous keratopathy has also been reviewed.

Honey is a supersaturated solution of sugars with an acidic pH, high osmolarity and low water content. These characteristics inhibit the growth of micro-organisms.[20] Additional antimicrobial activity is generated on dilution by the activation of bee-derived glucose oxidase to produce hydrogen peroxide.[20] In addition to the presence of these well-characterised major antibacterial factors in honey, methylglyoxal[21,22] and cationic antimicrobial peptide bee defensin-1[23] also act as antibacterial substances.

It is important to note that the concentration of these factors varies depending on the floral source and geographical origin of the honey. Honey contains a wide range of phytochemicals including the polyphenols (for example, flavonoids and phenolic acids). Manuka honey has significantly higher levels of antibacterial activity against *Staphylococcus aureus* and

Case report 1

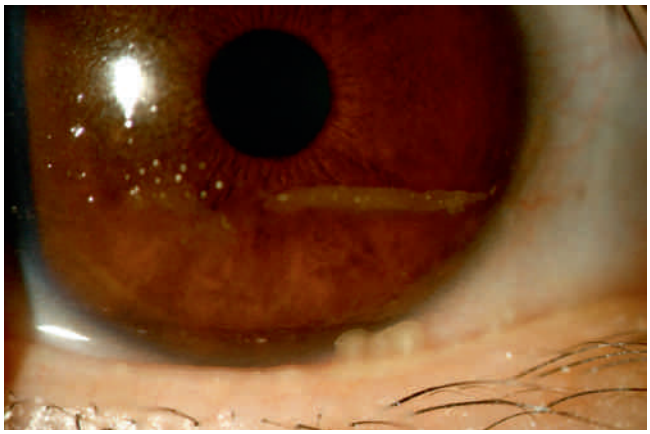


Figure 1. Meibomian seborrhoea in 39-year-old Asian female. Left lower lid margin and tear film. Non-responsive to lid hygiene, omega-3 dietary supplementation and unit dose lubricants.

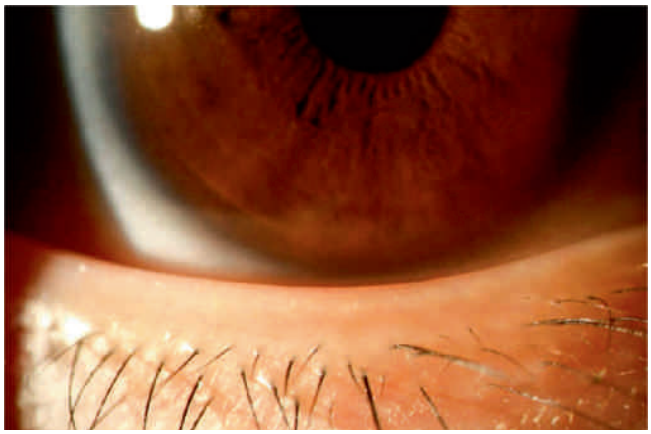


Figure 2. Left lid margin of same patient three months after antibacterial medical honey applied to lid margins twice daily. Significant improvement in lid margin and tear quality is reported.

in ocular surface disease management

Case report 2

A 59-year-old male presented with a 40+ year history of anterior and posterior blepharitis (obstructive meibomitis), hordeola and chalazia R > L; poorly controlled with lid hygiene, unit dose lubricants and omega-3 supplementation. Before and six weeks after Optimel antibacterial honey applied to lid margins bid following lid hygiene. Note honey residue on lashes. Lid margin telangestasia and meibomian gland orfice congestion reduced RE. Reduction in lid margin telangestasia and conjunctival injection LE.

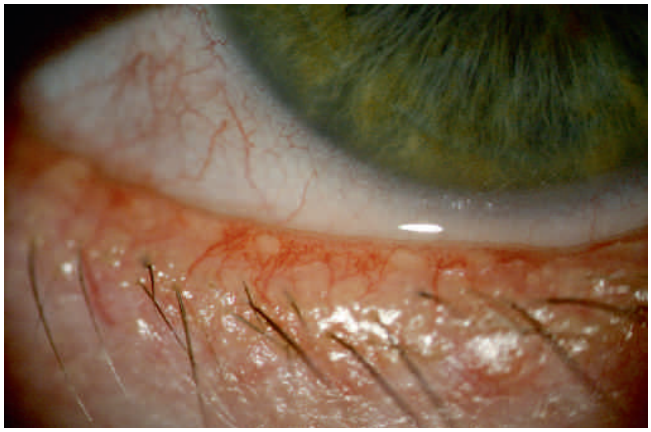


Figure 3. Right eye before Optimel

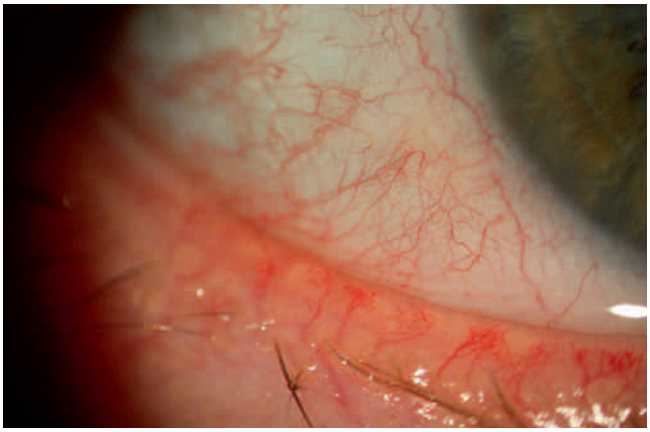


Figure 4. Right eye six weeks after commencing Optimel

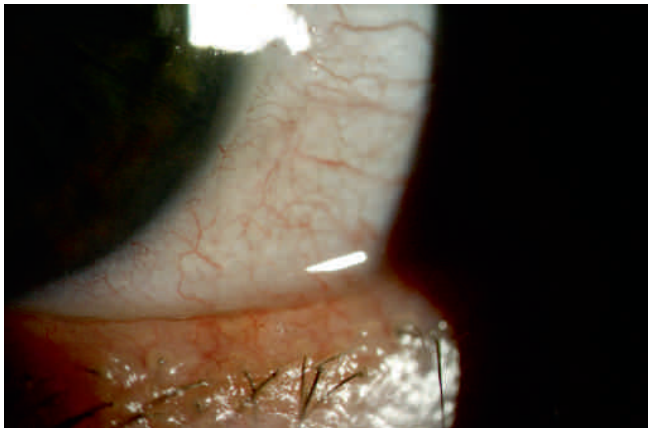


Figure 5. Left eye before Optimel

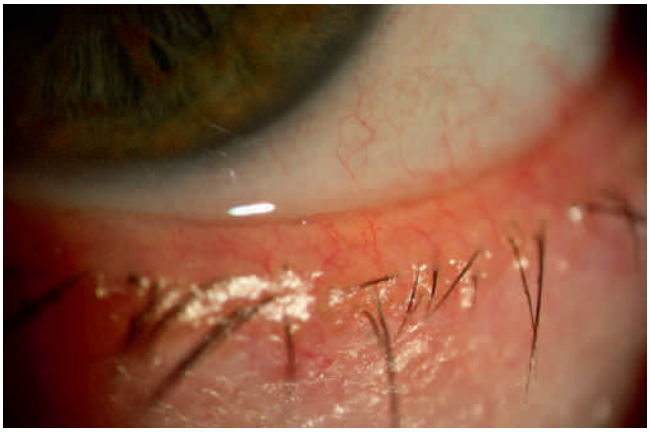


Figure 6. Left eye six weeks after Optimel commenced

higher levels of polyphenols and antioxidant activity than other honeys and is effective against antibiotic resistant bacterial pathogens including MRSA, VRE and *Pseudomonas aeruginosa*.[2-6] Synergistic effects of Manuka honey with antibiotics improves its *in vitro* activity against antibiotic resistant bacterial strains.[24,25] Manuka honey also demonstrates *in vitro* anti-viral activity.[26]

Leptospermum sp. honeys are light- and heat-stable and have a long shelf life. Activity is not influenced by the final sterilising procedure of gamma-irradiation. Antibacterial honey is not an antibiotic as it does not have 'a fast onset of antimactivity' defined as a reduction of bacteria and fungi in one to 10 minutes.

Recent animal models of ocular surface injury, inflammation and infection treated with honey have produced encouraging results. In animal models of *S aureus* and *P aeruginosa* conjunctivitis, honey reduces redness, swelling and time taken to eradicate bacterial pathogens and is as effective as topical antibiotics.[27,28]

In a rabbit model of *P aeruginosa* induced microbial keratitis, there were no significant differences in clinical signs between honey treated and ciprofloxacin treated eyes.[29] In a model of corneal abrasion and endotoxin-induced *P aeruginosa* keratitis, the anti-angiogenic and anti-inflammatory properties of honey were demonstrated.[30] The anti-inflammatory and antioxidant effects of pure raw Malaysia Tualang honey in an alkali induced corneal burn model were clinically and histopathologically equivalent to conventional therapy.[31]

Our decade of clinical experience with medical-grade Australian and New Zealand Leptospermum sp antibacterial honeys involves the treatment of many hundreds of patients for the following external eye

Continued page 30

Antibacterial medical honey

From page 29

conditions: bacterial conjunctivitis, anterior blepharitis, angular blepharoconjunctivitis, indolent herpetic keratitis, recurrent corneal erosion, post-viral dry eye, post-lasik dry eye, aqueous tear deficiency, meibomian gland dysfunction, Thygeson's superficial punctate keratitis, superior limbic keratoconjunctivitis, glaucoma medicamentosa and post-operative corneal oedema.

Improvements in symptoms and clinical signs were noted in the majority of cases and will be detailed in future publications. We have not experienced any adverse events from the use of antibacterial honey, although some temporary stinging, redness and epiphora occurs due to its low pH which is minimised by eye closure.

Clinical findings

We have published some results of a prospective open-label clinical study that assessed the effect of pure medical grade antibacterial honey on the ocular flora in patients with dry eye caused by aqueous tear deficiency and/or meibomian gland disease and poorly controlled by conventional treatments.[31] Bacteria isolated from the eyelid margin and conjunctiva fornix were identified and quantified before and after initiation of treatment with topical application of antibacterial Medihoney thrice daily.

Use of antibacterial honey significantly reduced total bacterial colony forming units (CFUs) for the eyelids and the conjunctiva of dry eye subjects from baseline at month 1 and 3. At month 3, the total CFUs for all dry eye subgroups were not significantly different from those of the non-dry eye group.[32]

Our clinical findings are supported by two recent clinical trials. A 25 per cent honey solution eradicated the bacterial flora in the conjunctival sac after one week in the perioperative period in patients scheduled for cataract surgery or vitrectomy.[33] The capacity of honey solution to eradicate ocular pathogens was not significantly different from that of 0.3% topical ofloxacin.[33] A 20 per cent honey solution applied topically for three weeks was more effective than artificial tears in controlling dry eye symptoms and signs including corneal erosions.[34]

Conclusions

Regulatory-approved, high efficacy ophthalmic antibacterial honey offers opportunities to both patients and eye-care practitioners. Many *in vitro* studies and animal studies confirm the antibacterial properties and the positive effects on ocular surface wound healing in a range of acute and chronic ocular surface conditions of medical grade Australian and New Zealand honeys.

Use of any medical product must be based on clinical justification and available evidence about product safety and effectiveness. Currently, more evidence is required to guide clinical practice and further research is needed to clarify the role of antibacterial honey as a primary or adjunctive treatment for acute and chronic dry eye and ocular surface diseases.

We look forward to advances made by others in understanding the mechanisms of action of antibacterial honeys, and to continuing our clinical research with this unique local product and sharing its impressive effects with eye-care practitioners. ■

Financial disclosure: Clinical research has been partially supported by Medihoney Pty Ltd (2004-2006) and Melcare Biomedical Pty Ltd (2013).

1. Sullivan DA, Hammitt KM, Schaumberg DA et al. Report of the TFOS/ARVO Symposium on global treatments for dry eye disease: an unmet need. *Ocul Surf* 2012; 10: 2: 108-116.
2. Irish J, Blair S, Carter D. The antibacterial activity of honey derived from Australian flora. *PLoS One* 2011; 6: 3: e18229.
3. Blair SE, Cokcetin NN, Harry EJ, Carter DA. The unusual antibacterial activity of medical-grade Leptospermum honey: antibacterial spectrum, resistance and transcriptome analysis. *Eur J Clin Microbiol Infect Dis* 2009; 28: 1199-1208.
4. George NM, Cutting KF. Antibacterial honey (Medihoney): *in vitro* activity against clinical isolates of MRSA, VRE and other multiresistant gram-negative organisms including *Pseudomonas aeruginosa*. *Wounds* 2007; 19: 231-236.
5. Schneider M, Coyle S, Warnock M et al. Antimicrobial activity and composition of Manuka and Portobello honey. *Phytother Res* 2012; Sep 18. doi: 10.1002/ptr.4844. Epub ahead of print.
6. Alzahrani HA, Alsabehi R, Boukraâ L et al. Antibacterial and antioxidant potency of floral honeys from different botanical and geographical origins. *Molecules* 2012; 17: 9: 10540-9. doi: 10.3390/molecules170910540.
7. Forrest RD Early history of wound treatment. *J Royal Soc Medicine* 1982; 75: 198-205.
8. Zumla A; Lulat A. Honey a remedy rediscovered. *J Royal Soc Medicine* 1989; 82: 384-385.
9. Aristotle (350 BC) Volume IV. Historic; animallum. In: Smith JA, Ross WD, eds. Works of Aristotle. Oxford University; Oxford, UK (translated by DAW Thompson, 1910).
10. Arrington GE. A History of Ophthalmology. MD Publications: New York, 1959.
11. Jones R. Honey and healing through the ages. In: Munn P, Jones R, eds. Honey and healing. IBRA International Bee Research Association; Cardiff, Great Britain; 2001: 1-4.
12. Meda A. Lamien CE, Milogo J et al Therapeutic uses of honey and honeybee larvae in central Burkina Faso. *Journal of Ethnopharmacology* 2004; 95: 1: 103-107.
13. Shenoy R, Bialasiewicz A, Khandekar R et al. Traditional medicine in Oman: Its role in ophthalmology. *Middle East Afr J Ophthalmol* 2009; 16: 2: 92-96.
14. Iqbal A, Orakzai OK, Ayaz M. Home remedies and traditional eye medicines used for the treatment of common eye ailments in District Swabi. *Journal of Postgraduate Medical Institute* 2012; 26: 432-438.
15. Bhardwaj A, Tanwar M. Effect of rasanjana madhu ashchyotana in netra abhishyanda (mucopurulent conjunctivitis). *Ayu* 2011; 32: 3: 365-369.
16. Mozherenkov VP, Miniaeva TG. The use of products from bee raising in ophthalmology and otorhinolaryngology (Russian). *Med Sestra* 1991; 50: 47-51.
17. Popescu MP, Palos E, Popescu F. Efficacy of combined biological therapy with bee products in localized palpebral and conjunctival eye lesions with reference to the clinico-functional changes. (Russian). *Rev Oftalmol* 1985; 29: 53-61.
18. Emarah MH. A clinical study of the topical use of bee honey in the treatment of some ocular diseases. *Bulletin of Islamic Medicine* 2001; 2: 5: 422-425.
19. Mansour AM. Epithelial corneal oedema treated with honey. *Clin Experiment Ophthalmol* 2002; 30: 149-150.
20. Cooper RA, Molan PC, Harding KG. The sensitivity to honey of gram-positive cocci of clinical significance isolated from wounds. *J Appl Microbiol* 2002; 93: 857-863.
21. Adams CJ, Boult CH, Deadman BJ et al. Isolation by HPLC and characterisation of the bioactive fraction of New Zealand manuka (*Leptospermum scoparium*) honey. *Carbohydr Res* 2008; 343: 651-659.
22. Mavric E, Wittmann S, Barth G, Henle T. Identification and quantification of methylglyoxal as the dominant antibacterial constituent of Manuka (*Leptospermum scoparium*) honeys from New Zealand. *Mol Nutr Food Res* 2008; 52: 483-489.
23. Kwakman PH, Zaat SA. Antibacterial components of honey. *IUBMB Life* 2012; 64: 1: 48-55.
24. Jenkins R, Cooper R. Improving antibiotic activity against wound pathogens with manuka honey *in vitro*. PLoS One 2012; 7: 9: e45600. doi: 10.1371/journal.pone.0045600. Epub 2012 Sep 26.
25. Müller P, Alber DG, Turnbull L et al. Synergism between Medihoney and rifampicin against methicillin-resistant *Staphylococcus aureus* (MRSA). *PLoS One* 2013; 8: 2: e57679. doi: 10.1371/journal.pone.0057679. Epub 2013 Feb 28.
26. Shahzad A, Cohrs RJ. *In vitro* antiviral activity of honey against varicella zoster virus (VZV): A translational medicine study for potential remedy for shingles. *Transl Biomed* 2012; 3: 2: 2. doi: 10.3823/434.
27. Al-Waili NS. Investigating the antimicrobial activity of natural honey and its effects on the pathogenic bacterial infections of surgical wounds and conjunctiva. *J Med Food* 2004; 7: 210-222.
28. Ilechie AA, Kwapong PK, Mate-Kole E et al. The efficacy of stingless bee honey for the treatment of bacteria-induced conjunctivitis in guinea pigs. *J Experimental Pharmacology* 2012; 4: 63-68.
29. Nejabat M, Astaneh A, Eghtedari M et al. Effect of honey in *Pseudomonas aeruginosa* induced stromal keratitis in rabbits. *J Appl Anim Res* 2009; 35: 101-104.
30. Uwaydat S, Jha P, Tytarenko R et al. The use of topical honey in the treatment of corneal abrasions and endotoxin-induced keratitis in an animal model. *Current Eye Research* 2011; 36: 9: 787-796.
31. Bashkaran K, Zunaina E, Bakiah S et al. Anti-inflammatory and antioxidant effects of Tualang honey in alkali injury on the eyes of rabbits: experimental animal study. *BMC Complement Altern Med* 2011; 11: 90.
32. Albietz JM, Lenton LM. Effect of antibacterial honey on the ocular flora in tear deficiency and meibomian gland disease. *Cornea* 2006; 25: 9: 1012-1019.
33. Cernak M, Majtanova N, Cernak A, Majtan J. Honey prophylaxis reduces the risk of endophthalmitis during perioperative period of eye surgery. *Phytother Res* 2012; 26: 4: 613-616.
34. Jankauskiene J, Jarushaitiene D, Cheksteryte V, Rachys J. Using 20% honey solution eye drops in patients with dry eye syndrome. *J Apic Res* 2007; 46: 232-235.

Banking on a donor for corneal transplants

In Australia and New Zealand, more than 2,000 patients a year benefit from this sight-saving procedure but demand for donors remains high.

Jenny Kellett
and
Helen Carter

The first corneal transplant recipient, Alois Glogar, had no antibiotics or drugs to prevent his body rejecting the new tissue. He had his eyelids sewn shut for 10 days before he knew whether the procedure had worked. The surgery was performed in 1905, in what is now the Czech Republic, and despite one of the corneas failing, Glogar regained vision in one of his eyes for the rest of his life.[1,2,3]

Since that ground-breaking procedure, hundreds of thousands of successful corneal transplants have been performed around the world, according to the Lions Eye Donation Service in Melbourne.

The first corneal transplant was performed in Australia in 1941 and now nearly 2,000 are performed each year.

There are significantly more referrals for eye and tissue donation than for solid organs, making it the largest donation and transplantation sector in Australia.

Eye banks have a range of responsibilities and goals, ranging from identifying the rights of potential donors through to offering support to donor families. The scope of their work includes reviewing medical history, evaluating donated corneas, performing eye retrieval surgery, packaging and distribution, and public awareness programs.

The Eye Banks Association of Australia and New Zealand (EBAANZ) is the peak body for eye donation and transplantation.

EBAANZ has six eye banks that provide the service of eye donation for the purpose of corneal transplantation. They are:

- Lions Eye Bank of Western Australia
- Eye Bank of South Australia
- Lions Eye Donation Service (Victoria and Tasmania)
- Lions New South Wales Eye Bank
- Queensland Eye Bank
- New Zealand National Eye Bank (Auckland)

Each eye bank works independently but if a bank is unable to provide a patient with a cornea from its home state, an eye bank located in another state will facilitate the transport of a cornea.

The type of organ or tissue that is able to be donated depends on a variety of factors, including the primary circumstances of death. While solid organs such as the heart, lungs and kidneys may be transplanted only when the donor dies of brain death, tissue and eye tissue (corneas and sclera) can be obtained from a donor whose death is either brain or circulatory.

Depending on the preservation method, corneas can he held refrigerated for up to seven days or up to one month in an incubator, before needing to be transplanted in a patient.

Criteria for donors

Most people are able to donate their corneas. Problems such as poor vision and cataracts do not prohibit a person from donating; however, they must meet certain medical criteria to be eligible. Cancer prevents an organ donation but does not prevent someone from donating their corneas.

Before a corneal donation is accepted, the candidates need to be assessed for their suitability. Contraindications include:

- Unknown cause of death
- Haematological malignancy
- Infectious disease, including HIV, hepatitis and meningitis
- Previous eye surgery or disease (some acceptable)
- Specific congenital disorders and rare syndromes
- Lifestyle risk factors for HIV and hepatitis.

A potential donor may be excluded if they have a history of ocular disorders including connective tissue disease, glaucoma, diabetes or cataract surgery. Each donor is considered on a case-by-case basis.

Recipients

There are three main indications for corneal transplant: to restore the shape of the cornea, to restore clarity and to restore integrity

Continued page 32

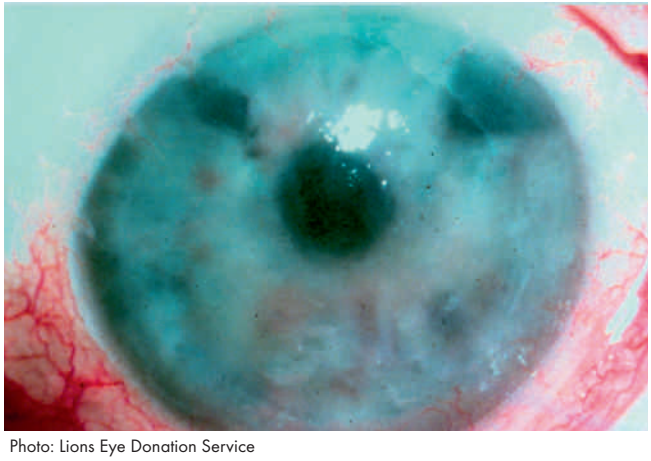


Photo: Lions Eye Donation Service

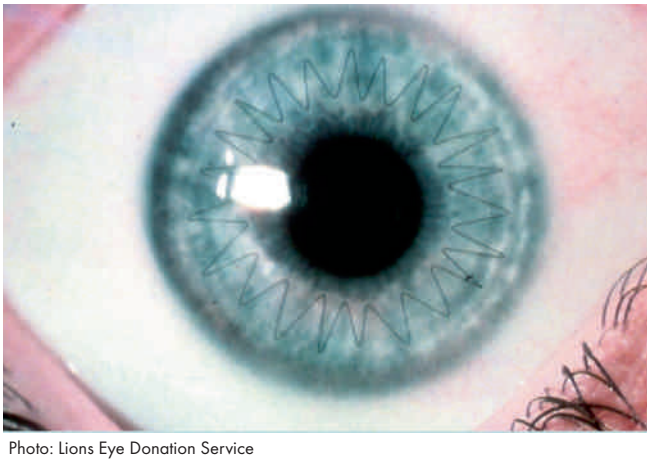


Photo: Lions Eye Donation Service

Banking on a donor

From page 31

of the cornea. Within these groups, there are conditions that benefit from corneal transplants.

Keratoconus accounts for about 30 per cent of corneal transplants, according to figures from the Australian Corneal Graft Registry. A further 50 per cent are for bullous keratopathy and Fuch's corneal endothelial dystrophy.

The rest are for other dystrophies and scarring of the cornea from keratitis, and a minority are to replace corneas because of trauma or perforation of the cornea from infectious or rheumatoid processes.

Dr Graeme Pollock, the director of the Lions Eye Donation Service, is a scientist specialising in organ transplantation who established the eye bank in Melbourne 22 years ago. He says there are far fewer corneal transplants today due to trauma or infection than there were 20 years ago.

'When I started, we always had a few cases in Victoria transplanted due to trauma each year but that has diminished greatly, due to better prevention now' he said.

'For example, there were more cases of herpes keratitis causing scarring on the cornea and requiring transplantation 15 to 20 years ago before the antiviral drug Ganciclovir, but there is a lower percentage now because the medication limits the damage.'

Dr Pollock says transplants fail in eight to nine per cent of patients in Australia within the first 12 months, mostly due to rejection. In these cases, further transplants are required.

'After a corneal transplant has been rejected once, the patient is at higher risk of the next one rejecting and so on,' he said.

Keratoconus patients have high success rates because there is no inflammation in the eye, so their rejection rates are only about two to three per cent in the first year.

Rejection can occur 20 or more years after transplantation.

Numbers

In 2012, there were 2,214 corneal transplants performed in Australia and New Zealand, according to EBAANZ.

The number rose markedly from 1,975 in 2011 to 2,214 in 2012. Big increases were also recorded from figures around the 1,600 mark in 2008, 2009 and 2010.

Until 2011, the number of people waiting for a transplant was rising but in 2012, the number dropped 20 per cent because of the increased number of corneal transplants performed.

'Fortunately, the Australian and New Zealand communities have generously donated in larger numbers and have more than kept pace with the increased need for transplantation,' Dr Pollock said.

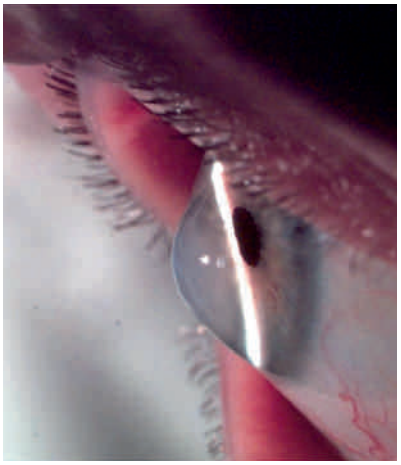


Photo: Lions Eye Donation Service

Endothelial keratoplasty

Dr Pollock says a recent increase in the number of transplants in NSW and WA is attributable not only to the increased number of donations, but also to the wider availability of surgeons and theatres. There are also more recipients due to a newer type of corneal transplant, endothelial keratoplasty.

'Endothelial keratoplasty is the biggest revolution in corneal transplants in more than 100 years—the world of sutureless corneal transplants,' Dr Pollock said.

'It's still in its early years—we have been doing them for only five years but already in Australia we have done several thousand. Depending on the state, endothelial keratoplasty accounts for 35 to 50 per cent of all corneal transplants, and in Victoria, they account for about 44 per cent.

'In the USA, they now exceed half of all corneal transplants.'

In this partial-thickness corneal graft operation, only the innermost corneal layers are replaced, instead of the whole thickness of the cornea as occurs in penetrating keratoplasty.

Unlike traditional transplants, endothelial keratoplasty replaces diseased corneal cells but retains a patient's healthy corneal tissue.

'We transplant the back half of the donated cornea, the endothelial layer. We make an incision in the anterior chamber from the side and take a very thin slice of corneal tissue, about 0.15 of a millimetre, and stick it onto the back of the recipient's cornea, after scraping off the existing (damaged) endothelial layer,' Dr Pollock said.

The operation is performed where poor function of the inner endothelial cell layer has led to corneal oedema. Corneal endothelial failure is seen in some genetically determined conditions such as Fuch's Dystrophy and is also a rare complication after intraocular surgery such as cataract extraction.

This procedure is also less invasive and requires less follow-up than standard transplantation, making it appealing to elderly patients with Fuch's dystrophy who now have an option for better vision.

The Lions Eye Donation Service was the first eye bank in Australasia to supply these pre-cut corneas, a service that saves surgeons about 45 minutes per transplant.

Role of optometrists

Optometrists can refer patients for corneal transplant. Optometrist Richard Lindsay in Melbourne has many keratoconus patients and often needs to refer them for transplant. He occasionally observes the surgical procedure.

Optometrists can have in their practices organ donor information pamphlets, which are available from Medicare, and discuss cornea donation with patients who are interested in registering as donors.

They can also refer patients with conditions requiring transplantation to the www.eyedonation.org.au website.

'Despite improvements, the demand for donor corneas remains high,' Dr Pollock said. ■

New South Wales	754
Queensland	510
Victoria	345
New Zealand	279
Western Australia	188
South Australia	111
Tasmania	23
Australian Capital Territory	12
Northern Territory	1
TOTAL	**2,214**

Corneal transplants, Australia and New Zealand 2012

1. *Br J Ophthalmol* 2006; 90: 10: 1222–1223.
2. Lions Eye Donation Service. http://www.cera.org.au/our-research/lions-eye-donation-service. Accessed 8 April 2013.
3. BBC online. http://news.bbc.co.uk. Accessed 8 April 2013.

Get Every Piece of the Puzzle

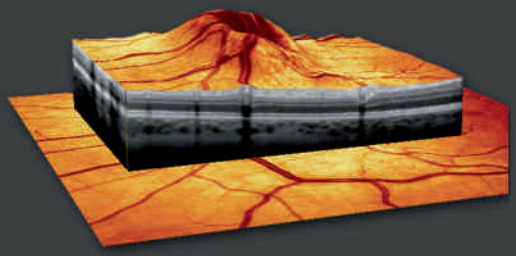
SPECTRALIS®

bluepeak®

multicolor™

Multi Modality Imaging

Multi modality imaging is the fusion of confocal scanning laser fundus imaging and Spectral-Domain OCT to offer unique perspectives of structure within the retina. The Blue Peak enabled version adds blue laser autofluorescence which provides insights into the health of the RPE/Photoreceptor complex without the need to inject dye.



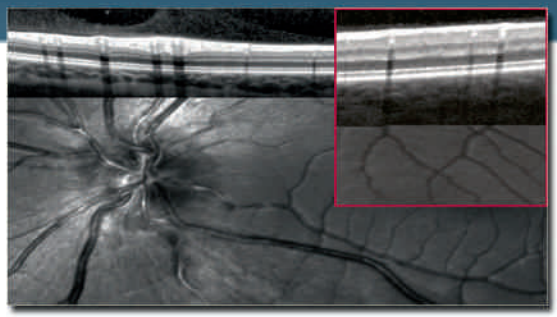
Reliable OCT Scans

TruTrack™ technology: This dual-beam system uses the cSLO fundus image to actively guide the OCT scan in real-time as the image is being captured, thus removing eye motion artefacts caused by micro-saccades of the eye or poor fixation.

TruTrack™ ensures real time alignment of follow up images at the same scan location on every visit, which is essential for monitoring disease progression.

High Contrast Images

Heidelberg Noise Reduction Technology reduces or eliminates OCT "snow" to provide crystal clear, high contrast images of retinal structures and pathology. CSLO retinal images are free from scattered light and low sensitivity inherent in flash photography.



NEW multicolor

See more with MultiColor™ laser fundus imaging. The specific laser colors capture information from different depths and structures of the retina and create detailed, high-contrast images. Simultaneous acquisition of MultiColor images and SD-OCT scans with the SPECTRALIS adds a new dimension to diagnostic imaging.

HEIDELBERG ENGINEERING

Your Australian Distributors:

Optech Diagnostic & Surgical P/L
404 Albert Street
East Melbourne VIC 3002

Ph: 03 9639 2125 Fax: 03 9639 2127
E-mail: info@optech.net.au
Internet: www.optech.net.au

XALACOM: It's a logical UPGRADE[1-4]

ADD POWER • NOT DROPS[2,3]

Xalacom®
latanoprost/timolol maleate

PBS Information: Restricted benefit. This product is listed on the PBS for the reduction of elevated intra-ocular pressure in patients with open-angle glaucoma or ocular hypertension who are not adequately controlled with monotherapy.

Before prescribing, please review Product Information available from Pfizer Australia Pty Ltd. (www.pfizer.com.au) **MINIMUM PRODUCT INFORMATION: XALACOM® (latanoprost 50 µg/mL and timolol 5 mg/mL)** Eye Drops. **Indications:** Reduction of IOP in open-angle glaucoma and ocular hypertension, if insufficient response to other medications. Not for initial therapy. **Contraindications:** Reactive airway disease including bronchial asthma (and history), or severe chronic obstructive pulmonary disease (COPD). Sinus bradycardia, sick sinus syndrome*, sino-atrial block*, second or third degree atrioventricular block, overt cardiac failure, or cardiogenic shock. Hypersensitivity to ingredients. **Precautions:** Beta-blocker systemic effects: cardiovascular/respiratory reactions; first degree heart block*; severe peripheral circulatory disturbance/disorders*; mild/moderate COPD*; consider gradual withdrawal prior to major surgery; beta-blocking ophthalmological preparations may block systemic beta-agonist effects (inform anaesthesiologist)*; anaphylactic reactions; caution in hypoglycaemia, diabetes, hyperthyroidism, myasthenia gravis; concomitant beta-blocker or prostaglandin not recommended. Ocular: change in eye colour due to increased iris pigmentation; heterochromia; eyelid skin darkening; changes in eyelashes and vellus hair; macular oedema; caution in other types of glaucoma; herpetic keratitis*; pseudophakia; aphakia; filtration procedures; corneal diseases*; blurring of vision; contact lenses. Do not use in pregnancy (Pregnancy category C), lactation and children. See PI for details. **Interactions with other Medicines:** Additive effects with other drugs; thiomersal; combined treatment with CYP2D6 inhibitors*. **Adverse Effects:** Ocular: eye irritation; hyperaemia; abnormal vision; visual field defect; increased iris pigmentation; eyelash and vellus hair changes; corneal oedema and erosions; blepharitis*; keratitis*; vision blurred*; dry eyes*; eye pain*; conjunctivitis*; macular oedema*; photophobia*; periorbital and lid changes resulting in deepening of the eyelid sulcus*. Systemic: serious respiratory and cardiovascular events (worsening of angina pectoris, cardiac failure*, pulmonary oedema); anaphylaxis; non-specific chest pain*; herpetic keratitis*; localised skin reaction on the eyelids*; skin rash*; pruritus*; headache*; dizziness*; depression*; dysgeusia*; vomiting*; abdominal pain*; muscle/joint pain*; sexual dysfunction*. See PI for details. **Dosage and Administration:** One eye drop in the affected eye(s) once daily. Other eye drops at least 5 minutes apart. See PI for details. V10712

*Please note change(s) to Product Information

 References: 1. Diestelhorst M et al. Ophthalmology 2006; 113: 70–76 **2.** Konstas AGP et al. Arch Ophthal 2005; 123: 898–902 **3.** Higginbotham EJ et al. Arch Ophthal 2002; 120: 915–922 **4.** Higginbotham EJ et al. Arch Ophthal 2010; 128: 165–172 McCann Healthcare XAL0298AustPharm P7101-Jan 2013

Pfizer Established Products