Sclerochoroidal Calcification:

An unusual lesion detected during routine diabetic eye screening

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Staffordshire Diabetic Eye Screening Programme

Introduction

Other retinal lesions or pathologies are not infrequently detected during routine diabetic eye screening and it is often challenging for retinal screener/graders and screening programmes to manage these patients effectively. What follows is a discussion of an unusual retinal lesion detected during a routine screening examination. It is based on a case study presented at the 2016 BARS conference.

Case report

A 62 year old white Caucasian lady presented for her first routine diabetic eye screening examination following a recent diagnosis of type 2 diabetes. She reported no new visual symptoms but mentioned that she regularly attended the renal clinic at the local hospital for monitoring of a condition called Gitelman's syndrome. She reported that this was diagnosed some years ago following a referral to hospital after her optometrist detected an abnormality at the back of her eye. Following investigation, her ophthalmologist referred her to a physician for investigation and did not arrange to see her routinely in the eye clinic.

The patient looked well and had visual acuities of 6/9 bilaterally. Her retinal images showed bilateral supero-temporal lobular deep choroidal lesions which were amelanotic and pale coloured ***(figure 1 and 2).***

figure 1,2.
Bilateral supero-temporal lobular deep choroidal lesions

The clinical history and clinical features were highly suggestive of sclerochoroidal calcification. Since the aetiology of this condition had already been established as Gitelman's syndrome, which was being actively monitored, referral for metabolic work-up was not indicated and routine digital imaging monitored the patient's retinal appearance.

Discussion

Sclerochoroidal calcification is a benign intraocular lesion which may be detected in asymptomatic individuals during routine examinations, such as diabetic eye screening[1]. Whilst the condition is often idiopathic it may be related to metabolic disturbances of calcium metabolism ***(see table 1)***, which may cause dystrophic or metastatic calcium deposition and need to be investigated by metabolic work-up . This might include serum and urine potassium, phosphorous, calcium and magnesium levels, together with serum, parathyroid and calcitonin levels[2].

Hypocalcaemia	Hyperparathyroidism
	Hypomagnesaemia
	Vitamin D intoxication
	Sarcoidosis
Renal	Gitelman's Syndrome
	Bartter Syndrome
Hereditary	Familial Articular Chondrocalcinosis

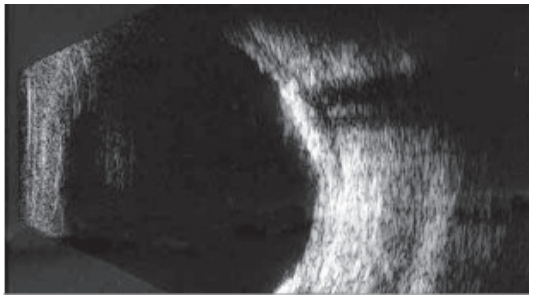
Table 1. Systemic causes of Sclero-choroidal calcification

Our patient had an inherited disorder of sodium and chloride transportation in the distal convoluted tubule of the kidney[3]. It is inherited in an autosomal recessive manner and named after Hillel J Gitelman, who was an American physician[4]. This condition tends to present in adulthood. It is distinct from Bartter syndrome, which, while being autosomal recessive with similar clinical manifestations, affects a different enzyme in a different part of the kidney (the loope of Henle) and presents in childhood[5].

Idiopathic sclerochoroidal calcification is likely to be the most commonly encountered cause of this lesion. It usually presents in older caucasian patients with supero-temporal lesions between the retinal vascular arcades and the mid-periphery and typically comprises multiple yellow-white sub-retinal lesions[6]. The calcification, which characterises these lesions, is said to begin in the sclera and cause atrophy of the overlying choroid. Although generally minimally elevated, lesions of up to 6mm in depth have been reported[7]. There is a suggestion that these lesions are bilateral in 84% of cases[8].

Although visual loss with sclerochoroidal calcification may occur as a result of a choroidal neovascular membrane and serous retinal detachment[9], its main importance is a potential for misdiagnosis for other choroidal lesions, such as choroidal metastasis, melanoma, naevus and osteoma[10].

Referral for further investigations where the diagnosis is uncertain is clearly indicated. Additional ophthalmic imaging often forms the main focus of those investigations, in particular ophthalmic ultrasound[11] and optical coherence tomography (OCT). This latter form of retinal imaging can be supplemented with additional enhanced depth imaging, which is of particular value when assessing this type of lesion[12].



Sclerochoroidal calcification has a characteristic appearance on ophthalmic ultrasound, comprising a highly reflective plaque with significant shadowing distal to the lesion ***(figure 3)***.

figure 3.
Ophthalmic ultrasound depicting plaque with shadowing distal in sclerochoroidal calcification

This could potentially be confused with choroidal osteoma, which has similar ultrasonography appearances ***(figure 4)***, but clearly arises from the choroid (differentiating it from sclerochoroidal calcification which arises from the sclera) on OCT-EDI ***(figure 5)***.

In addition, choroidal osteoma tend to occur unilaterally in the juxtapapillary region ***(figure 6)*** in healthy females in the second to third decade of life[13].

figure 4. Ultrasonograph of choroidal osteoma

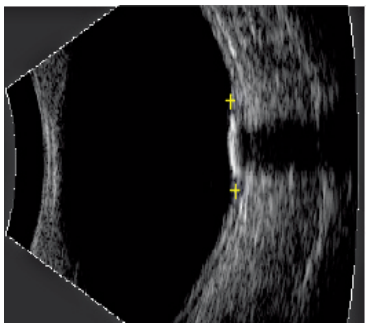
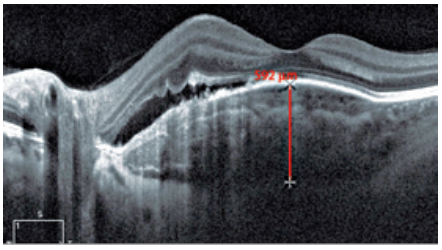


figure 5. OCT-EDI of choroidal osteoma



Fundus of choroidal osteoma in the juxtapapillary region ***- figure 6.***

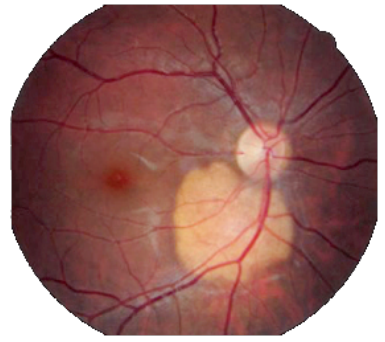
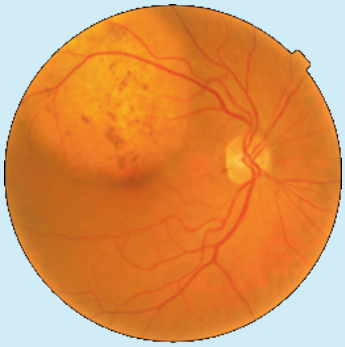


figure 7. Choroidal metastasis



Choroidal metastases represent the commonest intraocular malignancy and tend to be asymptomatic and not monitored in eye clinics[14]. ***Figure 7*** shows a choroidal metastasis from a lung primary in a patient who was asymptomatic and presented for routine diabetic eye screening.

90% of choroidal metastases occur at the posterior pole, with 50% of patients having bilateral disease and 33% having more than one tumor per eye. Ultrasound shows a choroidal lesion that tends to be broader than it is tall with high internal reflectivity. Sub-retinal fluid if often present ***(Fibure 8)*** and the commonest site for the primary tumour is breast in women (68%) and lung in men (40%).[15]

Choroidal melanoma is the commonest primary malignancy of the eye and is the second commonest primary melanoma in the body. It tends to occur in white Caucasians of North European decent, particularly those with light coloured irises. Its incidence is 6-7.5 million per year with peak at about 55 years of age. It is slightly more common in men. De-pigmented melanomas ***(figure 9)*** may resemble the other lesions described here, but may be differentiated by characteristic ultrasound appearances. In particular the classic “collar stud appearance” ***(figure 10)*** caused when the tumour breaks through Bruch’s membrane and its typical low internal ultrasonographic reflectivity, caused by the dense nature of these tumours ***(figure 11)***.

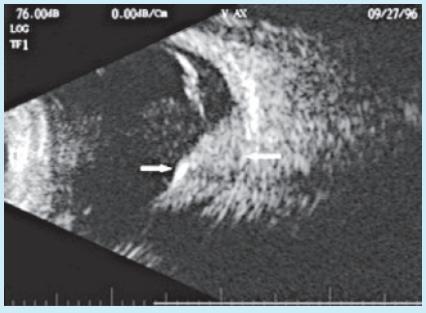


figure 8. Ultrasonograph of sub-retinal fluid

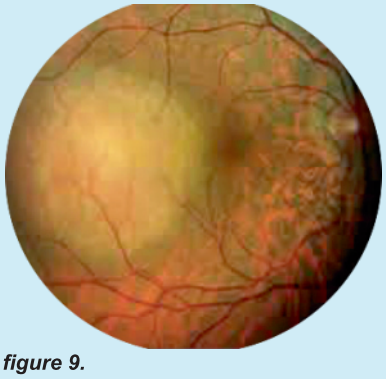


figure 9.
Fundus of depigmented melanoma

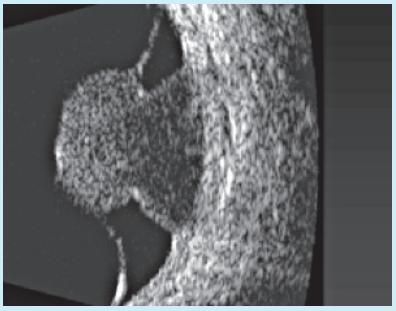


figure 10.
Ultrasonograph of tumour breakage through Burch's membrane

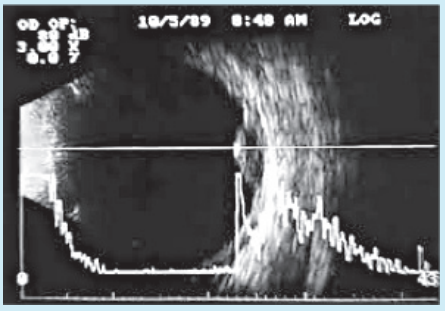


figure 11.
Ultrasonograph of tumour's high density

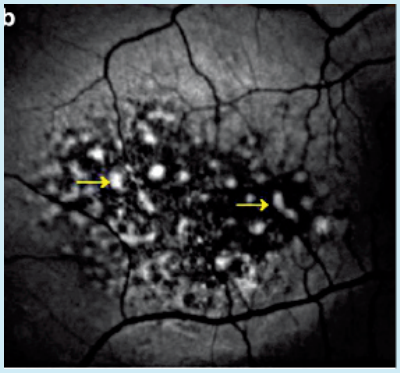
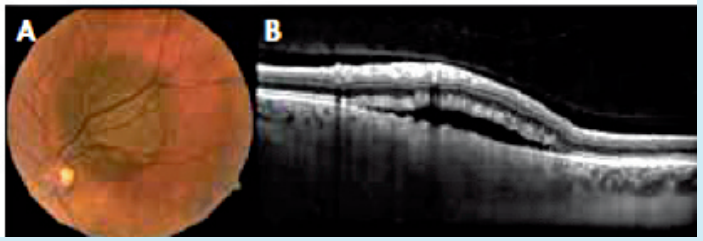


figure 12.
OCT of tumour's surface auto fluorescence

OCT may be used to demonstrate surface auto fluorescence due to lipofuscin ***(figure 12)*** and sub-retinal fluid and “shaggy” photoreceptors ***(figure 13)***, which are typical of this disease[16].

figure 13.
OCT of tumour's sub-retinal fluid



EDI-OCT may also be used for assessing lesion size in melanomas less than 3mm in height, but this imaging modality lends itself to the assessment of choroidal naevus.

Choroidal naevus occurs in 5-10% of Caucasians, and while there is a tendency to grow during puberty, growth thereafter is extremely rare. Conversion to malignant melanoma is also extremely rare occurring in 1 in 8,845 cases. They tend to be less than 3mm in diameter and 1.5 mm in height and may have a halo of RPE atrophy, signifying longevity ***(figure 14)***. Surface drusen also signify longevity and may be distinguished from the lipofuscin found on melanomas by an absence of auto fluorescence.

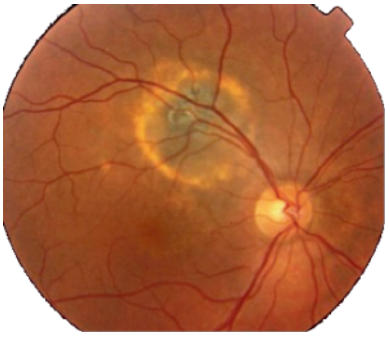


figure 14.
Fundus of naevus's halo of RPE atrophy

EDI-OCT may be employed to monitor the size of these lesions ***(figure 15)***, as they may be difficult to detect and measure accurately with ophthalmic ultrasound.

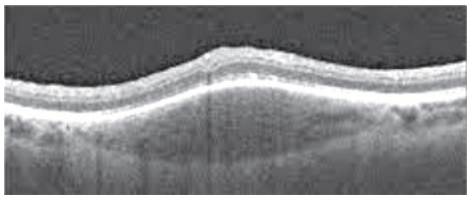


figure 15. EDI-OCT displaying scale of the naevus

Conclusion

It is hoped that by considering the possible diagnoses of a rare clinical presentation, the reader will be more confident in managing lesions of this nature that may be encountered opportunistically during diabetic eye screening and will have a deeper appreciation of the other imaging technologies that can be deployed by ophthalmology departments when attempting to arrive at a diagnosis.

References

1 Gupta R, Hu V, Raynolds T, Harrison R. (2005) Sclerochoroidal calcification associated with Gitleman's syndrome and calcium pyrophosphate dehydrate deposition. J Clin Pathol 58: 1334-1335

2 Honovar SG, Shields CL Demirci H, Shields JA (2001) Sclerochoroidal calcification: clinical associations and systemic associations Arch Ophthalmol 119: 833-40

3 Simon DB, Nelson-Williams C, Bia MJ, Ellison D, Karet FE, Molina AM, Vaara I, Iwata F, Cushner HM, Koolen M, Gainza FJ, Gitelman HJ Lifton (1996) Gitelman's variant of Bartter's syndrome, inherited metabolic alkalosis, is caused by mutations in the thiazide sensitive Na-CL cotransporter Nat Genet. 12(1): 24-20

4 Gitelman HJ, Graham JB, Welt LG (1966). A new familial disorder characterized by hypokalemia and hypomagnesaemia Trnas Assoc Am Physicians 79: 221-35

5 Simon DB, Karet FE, Hamden JM, DiPietro A, Sanjad SA Lifton RP (1996) Bartter's syndrome, hypokalaemic alkalosis with hypercalcuria, is caused by mutations in Na-K-2Cl cotransporter NKCC2 Nat Genet. 13(2): 183-8

6 Honovar SG, Shields CL Demirci H, Shields JA (2001) Sclerochoroidal calcification: clinical associations and systemic associations Arch Ophthalmol 119: 833-40

7 Sachchat AP, Robertson DM, Mieler WF (1992) Sclerochoroidal calcification Arch Ophthalmol 110: 196-9

8 Sachchat AP, Robertson DM, Mieler WF (1992) Sclerochoroidal calcification Arch Ophthalmol 110: 196-9

9 Leys, Slaimans P, Blanckaert J. (2000) Sclerochoroidal calcification with choroidal neovascularization Arch Ophthalmol 118: 854-857

10 Sivalingam A, Shields CL Shields JA (1991) Idiopathic sclerochoroidal calcification Ophthalmology 98: 720-724

11 Sheilds CL, Demirci H, Materin MA, Marr BP, Mashayekhi A, Shields JA. Clinical factors in the identification of small choroidal melanoma. Can J Ophthalmol. 2004;39(4): 351-357

12 Sheilds CL, Kaliki S, Rojanaporn D, Ferenczy SR, Shields JA. Enhanced depth imaging optical coherence tomography of small choroidal melanoma: comparison with choroidal nevus Arch Ophthalmol 2012 Jul;130(7): 850

13 Kadrmass EF, Weiter JJ (1997) Choroidal osteoma Int Ophthalmol Clin 37(4): 171-82

14 Giuliari GP, Sadaka A (2012) Uveal metastatic disease: current and new treatment options (review) Oncol Rep 27(3): 603-7

15 Shields CL, Shields JA, Gross NE (1997) Survey of 520 eyes with uveal metasteses Ophthalmology 104: 1265-76

16 Shay EAT, Shah SU, Ferenczy S, Shields CL. Optical Coherence Tomography of Retinal and Choroidal Tumours Journal of Ophthalmology Volume 2011 (2011), Article ID 385058, 12 pages

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My experience of Becoming an Assessor in Level 3 Certificate in Vocational Achievement

I recently undertook the CAVA (Level 3 Certificate in Assessing Vocational Achievement) qualification with NOCN (National Open College Network) and found it to be a very rewarding and positive experience.

I have been a Screener/Grader for 12 years and have been assessing the City & Guilds Diploma for 7. The CAVA took me about 4 months to complete, although it could have taken less time had I really thrown myself into it!

The key to achieving the qualification is providing evidence that you meet the criteria of the course. On enrolling I was provided with the course information and a book by Hilary Read called, 'The Best Assessors Guide'. I was contacted by my Assessor, a very nice lady called Jackie, and she ran through the process with me, I was also sent a Skills Scan to complete.

A Skills Scan is used to identify previous and current experience and activities which match the requirements of the qualification; this information is then used to develop an Individual Assessment Plan.

On the face of it, it all looked a bit daunting, but once I got into it I realised that much of the terminology applied to skills I had used naturally without putting a name to them, for example using 'holistic' assessment. A holistic assessment looks at a task as a whole allowing you to assess different areas at the same time, for example, for an activity such as instilling eye drops evidence may also be provided which shows good hand hygiene, working relationships and health and safety.

Providing the evidence was relatively straight forward. I contacted two of the Screeners I had previously assessed and took a copy their assessments. I also contacted two colleagues who were able to confirm via an, 'Expert Witness Statement' that they'd worked with me and seen me carry out assessments. On request of my assessor, I wrote a small amount on a couple of areas that I hadn't covered to show that I understood what they were all about, using the Best Assessors Guide as reference. Finally, and probably the scariest part, I had a telephone conversation with my Assessor which was taped to provide evidence of what we had spoken about. Now don't get me wrong, my Assessor was lovely but there is definitely something about knowing that you're being taped that makes you feel very nervous and your mind go blank, or perhaps that's just me?!

That was it in a nutshell really, it's probably worth mentioning that the evidence you can provide doesn't have to refer to the City & Guilds Diploma, I carry out regular Screener Assessments in clinic, and was able to use these as part of my evidence. My assessor was really helpful and if there was an area that I hadn't covered she pointed me in the right direction and made suggestions.

I now feel much more confident and professional when assessing. I have a good understanding of the different assessment tools that can be used and appreciate the importance of providing good evidence, both for myself and as an assessor and for the learners too.

Once completed the CAVA is totally transferable and can be used to assess any area of work, not just Diabetic Eye Screening. Assessors are used in Colleges and businesses alike, who knows what the future may hold…

Jane Starr
Senior Diabetic Eye Screener
Western Sussex Hospital NHS Foundation Trust

NHS Diabetic Eye Screening Programme Update

Qualification update

Since its launch in April 2016 nearly 150 learners from the diabetic eye screening, abdominal aortic aneurysm and newborn hearing screening programmes have registered on the new Level 3 Diploma for Health Screeners. Feedback from local screening programmes and learners has been good and the ability to tailor assessment methods to individual learners has proved particularly popular.

PHE Screening held 6 update sessions in Manchester and London to give local programme staff the chance to participate in interactive presentations and discussions on the qualification with awarding organisations and the national team. Nearly 300 people attended these events in total and provided some very good feedback and discussion.

We are aware that the 13 mandatory cross-programme units are a new addition to the training of learners within local screening programmes. However, the content of these units should have been covered in previous training. The new qualification formalises these skills and the knowledge required for working within diabetic eye screening. To reduce the workload of assessing the mandatory units, PHE screening in conjunction with The National Skills Academy, has produced a matrix which cross references the learning outcomes and will enable learners to use the evidence they submit across a number of units and multiple learning outcomes. This will be available shortly on the PHE Screening CPD website.

CAVA qualification

As of the end of February 2017, PHE Screening, in conjunction with the awarding organisation NOCN, has funded and facilitated the training of more than 300 individuals to undertake the Certificate in Assessing Vocational Achievement (CAVA) across the three screening programmes.

The CAVA qualification is a requirement for individuals who assess learners on the new qualification. Feedback from those undertaking and completing the CAVA qualification has been excellent. Learners say it is has improved their assessing and training skills.

There is still funding available for places on the CAVA qualification. If you have experience of assessing on the previous qualification, or significant experience of assessing in a different field, please sign up on the PHE Screening CPD website.

Administrative qualification

The previous qualification for administrative staff is no longer available due to the previous provider withdrawing its support. However we have produced a list of competencies for admin staff working within diabetic eye screening that local programmes can use to support new and existing members of administrative staff. The document is available on the PHE Screening CPD website.

Slit lamp biomicroscopy training framework

We updated the slit lamp biomicroscopy (SLB) training framework earlier this year to incorporate the new qualification and to simplify the process of becoming an SLB examiner. It is available on the PHE Screening CPD website.

Funding for the qualification

PHE Screening is administering funds provided by Health Education England for new learners undertaking the Level 3 Diploma for Health Screeners and the CAVA qualification. The funding process is outlined on the PHE Screening CPD website.

Funding is currently limited to 2 new or replacement members of staff per programme per financial year. More funding may be available on a case by case basis. Please note the funding does not cover programmes that have had a change in model of screening as this should have been incorporated into the commissioning arrangements.

Expert witnesses

Expert witnesses can be used to help support local programmes in providing and assessing the qualification. An expert witness can be used when it is not possible or practical to have the CAVA qualified assessor available in the same location as the learner.

An expert witness would be expected to provide a signed written testimony about the quality of a learner's competency, knowledge and/or performance in regards to the specific learning outcomes of the unit the learner is undertaking and being assessed on.

The expert witness must be an occupationally competent individual who understands the screening programme and the learning outcomes they are expected to provide testimony for. They are expected to be in a managerial, senior or supervisory position.

Further information regarding expert witnesses is available by contacting the awarding centre your local programmes is registered with.

PHE Screening CPD website

More information about the Level 3 Diploma for Health Screeners and the documents and links are available on the PHE Screening CPD website; *https://cpdscreening.phe.org.uk*

PHE Screening blog

The PHE Screening blog provides up to date news from all NHS screening programmes, including diabetic eye screening – replacing our previously published newsletters.

You can register to receive updates direct to your inbox, so there's no need to keep checking for new blogs.

You can sign up to the blog using this link; *https://phescreening.blog.gov.uk/*

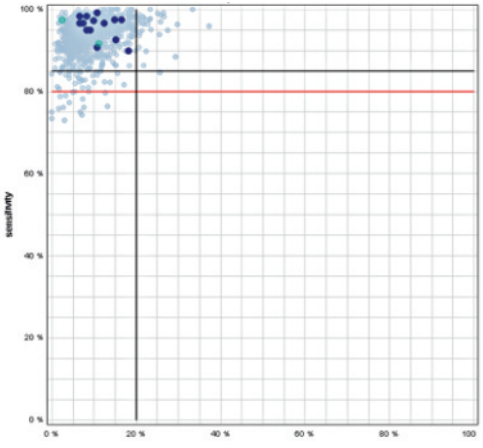
NHS Diabetic Eye Screening Programme national grading update

In September, we told you that we wanted to use validated measures to demonstrate that local services are grading to a consistent high quality – and to help drive up quality where needed.

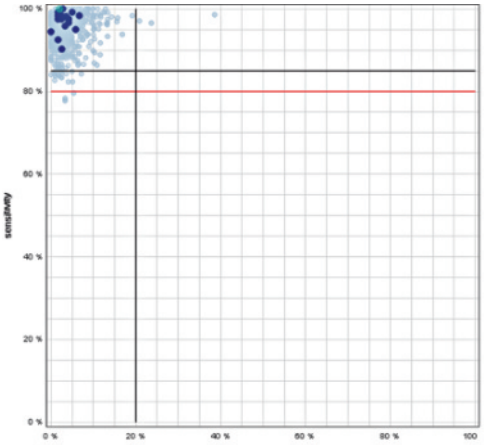
Since then, we have recruited 11 local services to help us look at ways to do this. These services extracted specific grading data which was analysed by a statistician. This analysis showed there was significant variation among services in the progression from no disease to referable disease grades between 2 screening events. The 11 services are currently auditing this to look for any reasons for the variation, and if any action is needed to improve their grading.

Nationally, the proportion of images graded R0M0 varies from 55% to 86% and we want to find out why. We suggest all local screening providers should think more about the R0 / R1 threshold. Providers need to make sure graders are not regularly missing early disease, such as microaneurysms. This will become more important when screening intervals are extended to 2 years for patients who have an outcome of no disease for 2 consecutive years. We are making progress in our plans to use automated grading to check the quality of grading at this level. This will tell us whether or not a local service needs to review and improve its grading quality.

The test and training (TAT) reports are a useful grader performance monitoring tool for providers who present them at programme board meetings to the screening quality assurance service (SQAS) and commissioners to give assurance of quality grading. The reports have contributed to improved national grading quality and show national graders have a high sensitivity and specificity to any sight threatening disease (STDR). The scatter plots below demonstrate a noticeable improvement in the year 2016 compared to 2015. Each dot represents a grader and these dots have clumped closer together towards the higher sensitivity and specificity corner of the plot. This is a measure of national grading improvement and is very reassuring.



Sensitivity / specificity to any STDR – January 2015 to December 2015



Sensitivity / specificity to any STDR – January 2016 to December 2016

You can generate these plots in the TAT system by clicking on grading management reports > select period (must be 12 months) > STDR chart.

The BARS education project

Since 2001, The British Association of Retinal Screening (BARS) has been the UK's professional organisation for those who provide eye screening services for people with diabetes. Our members include retinal screeners, graders, administrative and failsafe staff, programme managers, optometrists and ophthalmologists – in fact anyone with a professional interest or involvement in diabetic eye screening.

Founded by Professor Roy Taylor and Lillian Lovelock from the Newcastle-upon-Tyne screening programme, who were among the early pioneers of retinal screening in this country, BARS is a not-for-profit organisation, run by an elected council of volunteers who are drawn from a range of roles within the field of diabetic eye screening, and our aim is to support our fellow professionals in a variety of ways, allowing them to provide the best possible service for patients.

Education and training has always been a key part of the associations work, and in recent years we have provided tutorial days for those undertaking the City & Guilds Diploma in Diabetic Retinopathy Screening, discussion days for those involved in failsafe and administration, and regular meetings for screening programme managers and team leaders.

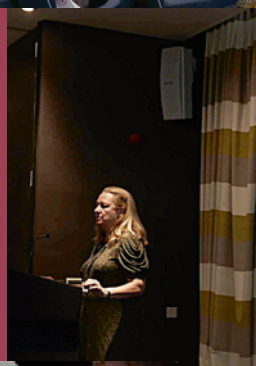
As the current BARS Chair, I am keen for the association to play an increasingly active role in the education and development of screening staff, for whom career progression within their chosen field has traditionally proved challenging, and I am fortunate to be joined on council by a team of highly experienced and dedicated individuals who share that view and are willing to put in the time and effort required to make a truly significant and positive change to the working lives of screening professionals.

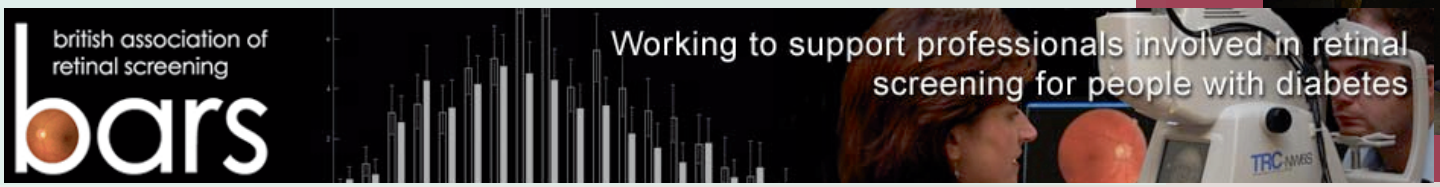
With the support of the National Programme, BARS is therefore exploring the development of a new advanced qualification for those who have completed the City & Guilds Diploma in Diabetic Retinopathy Screening or the Level 3 Diploma for Health Screeners. Our proposal is for a new nationally recognised qualification that would aid career progression within the field of diabetic eye screening, and build on the diploma that already exists.

This is an ambitious project that will require a complete understanding of the needs of screening staff so that we can develop a qualification that meets those needs and will prove useful and relevant.

BARS is currently gathering feedback from members, so if you currently work in diabetic eye screening and are not already a member of the association, please join now for free via our website at www.eyescreening.org.uk. Click on the Membership link to join, or the Education link to contribute to our research. Your opinions will help us as we continue in our work to support professionals involved in retinal screening for people with diabetes.

Phil Gardner, BARS Chairman





The 2016 Conference summary

The 16th Annual BARS Conference was held in Birmingham on the 22nd and 23rd of September 2016, and was attended by approximately 220 delegates who enjoyed a range of high quality presentations by speakers from all over the country.

The National Programme was represented by John Fox and Patrick Rankin, who gave updates on the progress of NDESP's Intervals Project which will introduce 2 year screening intervals for low risk patients, and on the new Diploma for Health Screeners that was introduced in 2016.

Among the clinical topics covered at the conference was the issue of diabetic retinopathy in children, and whether the current starting age of 12 is suitable for screening or should be varied to take into account the patient's duration of diabetes. Professor Tim Barrett of Birmingham Childrens' Hospital presented evidence suggesting that more than 8% of under-12s with diabetes have retinopathy, and that screening from the point of 6 years duration of diabetes may be sensible.

A number of clinical case studies were presented by those working on the front line of screening, and these covered diverse topics from proliferative retinopathy to rod/cone dystrophy and sclero-choroidal calcification.

Ground-breaking research was high on the agenda at this year's conference, with Georgios Leontidis of the University of Lincoln presenting evidence on Retinal Vascular Geometry, looking at novel biomarkers which indicate the early development of diabetic retinopathy. The outgoing BARS Chairman, Grant Duncan, spoke about the development of automated diabetic retinopathy image assessment, while Mike Black of the Scottish Diabetic Retinopathy Screening Programme described their experience of using such a system.

Perhaps the most surprising conclusion from a piece of research came courtesy of Dr Gaby Judah from Imperial College London, whose IDEAS Trial (Incentives in Diabetic Eye Assessment by Screening) looked at whether financial incentives would increase attendance for screening. Having described her methods, which involved offering patients £10 to attend their appointment, Dr Judah presented her results – and was greeted with a collective gasp from the room, when it was revealed that offering an incentive had actually decreased attendance!

In addition to clinical presentations, the administration and failsafe of screening was covered in talks by Jo Unwin and Cressida Darby from the Birmingham Heartlands DESP, who spoke about the management of pregnant patients, and Alison Byatt and Zoe Tobin from the West Sussex DESP, who presented innovative ways to improve patient experience through the better management of referrals, recalls and nursing home patients.

Patient perspective was a key part of this year's conference, with one of the most popular presentations coming from Simon O'Neill of Diabetes UK, whose talk 'Living the Day Today' provided an engaging and highly informative view of the challenges of living with diabetes, and offered invaluable insights which will no doubt improve our understanding and appreciation of the situation faced by our patients, allowing us to serve them better.

Bookending the main conference programme were additional meetings organised by BARS Council, one for those in management positions, looking at ways of improving programme performance and patient care, and one for those dealing with patient failsafe and the management of patients through the entire screening pathway.

All of the conference presentations mentioned above are available for download from the BARS website. Visit *www.eyescreening.org.uk* and click on the Conferences link, where you will also find details of this year's conference, due to take place in Leeds on the 21st and 22nd of September 2017.

Retinal Artery Occlusions and Diabetic Retinopathy Screening

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Retinal artery occlusion (RAO) may occur in the central retinal artery or in its branches, and also in the posterior ciliary arterial circulation. One of the most important figures in nineteenth-century ophthalmology, Von Graefe (1828-1870), was the first to describe the classic clinical picture of retinal artery occlusion in 1859.

Since the introduction of the National Diabetic Eye Screening Programme (NDESP) in 2006, it has become clear that a number of other conditions are important to identify and therefore lead to appropriate clinical outcomes and management. Retinovascular diseases (retinal vein and artery occlusions) are one of the major causes of visual loss and blindness in diabetic subjects in this century, but in addition it is an important predictor for cardiovascular disease and endpoints of myocardial infarction and stroke. Whilst retinal artery occlusion (RAO) is less prevalent than retinal vein occlusion (RVO) (ratio of approximately 9 RVO to 1 RAO in the UK), it is still important to identify for management within the Diabetic Eye Screening Programme (DESP). This article will outline the key points that will guide appropriate identification and management.

Significance

Occlusion of the central retinal artery (CRAO) or of a branch retinal arteriole (BRAO) are important ophthalmic emergencies.

There are four key areas of significance:

1. It causes significant painless unilateral loss of vision due to ischaemic damage to the retina or optic nerve
2. It may need urgent management to attempt reversal of the occlusion
3. It is often symptomatic of other significant pathology and underlying risk factors
4. It may herald a cardiovascular event e.g. myocardial infarction or stroke

Acute presentation of RAO to a DESP is rare owing to the acute visual loss, resulting in emergency ophthalmological assessment separate from screening. It is the longer term retinal appearance and sequelae that are usually identified by DESP and therefore graders at all levels should be familiar with these.

Clinical Features of RAO

The key clinical features include:

1. Amaurosis fugax (fleeting uniocular short lived visual loss), transient cerebral ischaemia, stroke and ischaemic heart disease are common cardiovascular events preceding retinal artery occlusion.
2. Occurring in two forms of RAO; occlusion of the Central (CRAO) and Branch (BRAO) retinal arteries
3. Sudden, painless, unilateral visual loss varying in degree from complete blindness in a CRAO to visual field defects in a BRAO.
4. The retinal signs will depend on the duration from the acute occlusion. In a CRAO the retinal appearance is one of marked ischaemia (***figure 1***) with retinal and optic disc oedema, a cherry-red spot at the macula (due to continuing blood supply from the unaffected choroidal circulation), intra-arteriolar blood column segmentation, and red area of retina temporal to the optic disc (an area supplied by the cilio-retinal artery). A relative afferent pupillary defect is usually identified.
5. An embolus (***figure 2***) may be identified resulting in a BRAO (***figure 3***) with segmental retinal oedema and resulting segmental visual field loss.
6. Signs of longstanding resolved CRAO are those of an arteriolar ghost vessel and optic disc pallor (***figure 4***). New vessels may develop in up to 14.5% and these may develop on the iris - rubeosis iridis (***figure 5***). Similar changes may be seen in BRAO but limited to the retinal segment affected, but not with rubeosis iridis.

Causes

Retinal artery occlusion (***figures 2 & 3***) is usually due to an embolus from elsewhere in the arterial circulation, usually from atheromatous macrovascular disease in the carotid artery or aorta, but less commonly may arise from disease of the heart valves, e.g. aortic stenosis and mitral valve abnormalities. Interestingly, most cholesterol emboli lodging at the bifurcation of a retinal arteriole do not necessarily cause complete obstruction of the blood flow (***figure 2***), such that there may be no obvious signs of retinal arterial obstruction to complete obstruction. A RAO may also be associated with complete carotid occlusion.

The risk factors for RAO are similar to macrovascular disease, and include cigarette smoking, diabetes mellitus, hypertension and end-stage renal disease: shown in **Table 1**. Note that cigarette smoking is prominent as a causative factor.

Emboli can also arise from thrombosis in the left atrium of the heart, particularly in association with cardiac rhythm disturbances such as atrial fibrillation. Less common sources of emboli are from infected heart valves in bacterial endocarditis, tumours of the heart such as myxoma, and rarely from venous thrombo-embolism via a patent foramen ovale connecting the right and left atria.

Inflammation of the cranial arteries as occurs in giant cell (temporal) arteritis, systemic lupus erythematosus, Wegener's granulomatosis and polyarteritis are less common causes of retinal artery occlusion. Similarly thombophilic disorders that enhance the clotting mechanisms such as high platelet counts, hyperhomocysteinaemia and Factor V Leiden may be identified. Retinal artery occlusion may occur as a result of ophthalmic surgery and has been reported following vasospasm associated with migraine and hypotension.

This extensive list of causes points to the importance of medical investigation and treatment of identified underlying cause.

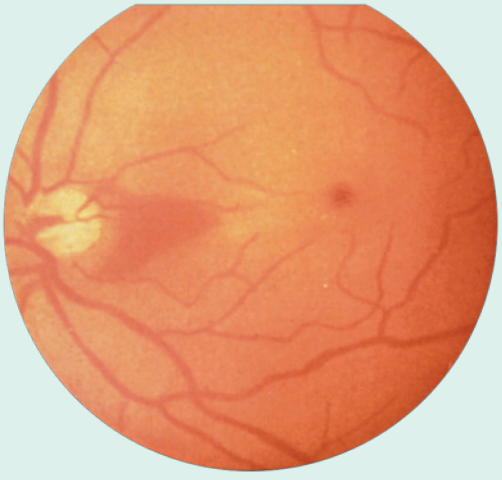


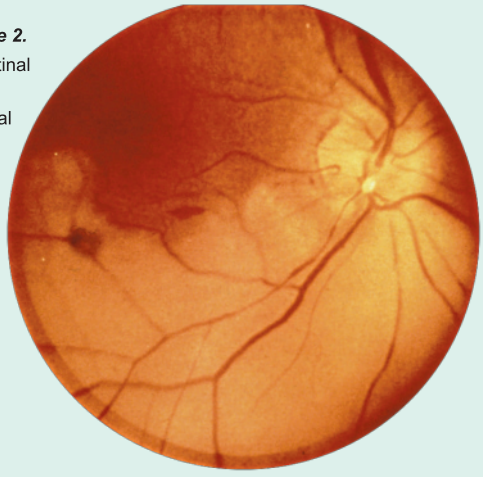
figure 1. A retinal photograph of an acute central retinal artery occlusion. It shows the retina pale and oedematous due to retinal ischaemia except for an area in the shape of a tongue temporal to the optic disc in which circulation is still retained by the ciliary circulation. Note also the cherry red spot at the fovea.

Table 1. Medical conditions underlying subjects with retinal occlusion at presentation

Prevalence of:	Branch retinal artery occlusions	Central retinal artery occlusions
Smoking	60%	43%
Hypertension	59%	66%
Hyperlipidaemia	50%	45%
Diabetes mellitus	7%	5%
Carotid bruits	11%	25%
Previous angina/myocardial infarction	23%	12.5%
Previous TIA/CVA	11%	10.5%
Peripheral vascular disease	9.8%	8.9%
Valvular disease (from echocardiography)	*30%	*15%

Data from Physicians clinic, Birmingham and Midlands Eye Centre of 120 consecutive patients
* Data from physician's clinic at Moorfields Eye Hospital

figure 2.
A retinal photograph of an acute branch retinal arterial occlusion caused by a cholesterol embolus in the origin of the inferior temporal artery. There is a pale ischaemic area of retina in the inferior temporal region.



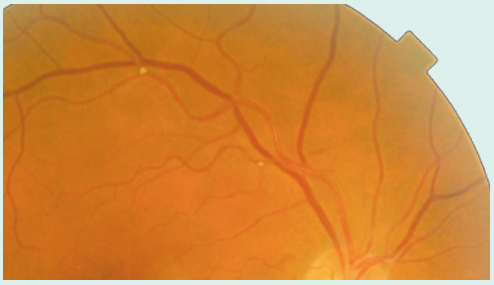


figure 3.
A retinal photograph demonstrating 2 retinal emboli lodged in the bifurcations of the superior temporal artery but without arterial obstruction.

Other Lesions

figure 4. This retinal photograph shows resolved changes of a BRAO, illustrating vascular ghosting (white appearance due to lack of blood flow) of the retinal arterial circulation in both superior and inferior temporal regions.

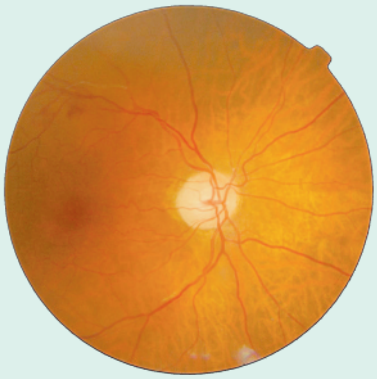
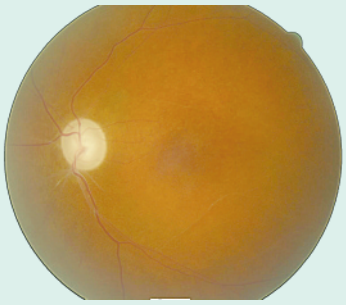


figure 5. This retinal photograph is of an old CRAO where there is markedly reduced blood vessels, an atrophic retina, and optic atrophy. Vision was perception of light only.



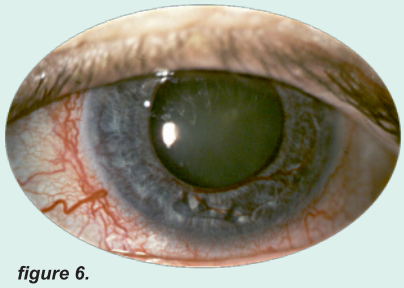


figure 6.
An anterior chamber view demonstrating new vessels growing on the anterior surface of the iris, termed iris neovascularisation or iris rubeosis. This is a sign of severe retinal and ocular ischaemia.

Investigations

An ophthalmological examination is needed to confirm the diagnosis of acute RAO. OCT scanning will show a range of capillary ischaemia in the superficial and deep capillary plexuses according to the type of RAO. Medical assessment is required to identify underlying risk factors and other, rarer causes. The usual tests will include a full blood count, ESR/CRP for evidence of inflammatory disease, an autoimmune profile, serum protein electrophoresis, thrombophilia screen (especially for younger patients), and clinical assessment of cardiac rhythm, with subsequent carotid doppler and cardiac ultrasound studies.

Treatment

Acute RAO

The condition warrants urgent management, as patients treated within 12 hours are more likely to benefit. A number of therapies have been used in the treatment of CRAO in the past in an attempt to dislodge the embolus. These include firm ocular massage through closed eyelids for 15 minutes, 5% carbon dioxide inhalation, acetazolamide infusion, ocular paracentesis, as well as various vasodilators such as sub-lingual isosorbide dinitrate, and intravenous glyceryl trinitrate. None of these therapeutic efforts have been shown to alter the natural history of disease definitively.

Recent interest has developed in thrombolytic therapy, delivered either intravenously or intra-arterially by direct catheterisation of the ophthalmic artery. As in the management of a stroke, this therapy must be deployed within a short time window, probably within 6 hours of onset of symptoms. Whilst a number of observational series have shown that the recovery of vision can be quite dramatic, two recent randomised controlled trials have not demonstrated efficacy. Such thrombolytic therapy may result in an increased risk of intracranial and systemic haemorrhage.

Medical Management

Systemic therapies of risk factors are required in most cases and include treatment for hypertension, statins, cigarette smoking cessation and anti-platelet drug therapy. These therapies are aimed at preventing or ameliorating associated cardiovascular disease e.g. myocardial ischaemia or cerebrovascular disease. Anticoagulant therapy will be required for atrial fibrillation, and carotid doppler studies may indicate a referral is needed for consideration of surgical intervention (carotid endarterectomy or stenting) for carotid stenosis. Steroids will be required urgently if giant cell arteritis is a likely cause.

Ocular and Medical Prognosis

Ocular prognosis will depend on the site of the occlusion, the underlying cause and the promptness of therapy. Limited recovery of visual acuity can be expected in 20% of patients with CRAO. Good visual acuity may be preserved in a BRAO unless the macular vessels are involved. In contrast to retinal vein occlusion where recurrence is common in the fellow eye if underlying medical risk factors are not treated, the chance of recurrence of RAO in the fellow eye is very low, with reports of an event rate as low as 1% over a mean follow up of 4.2 years.

With regard to overall prognosis, an early report suggested a high mortality in patients following a RAO of 60% within 2-3 years of the retinal event. However later studies have shown a lower mortality rate of 8% per year, with 7.4% sustaining stroke in the first year and 2.5% per year following. However the major cause of mortality was accounted for by a coronary event (59% of all deaths). A recent extensive systematic review of all the literature on associations of RAO to cardiovascular disease has confirmed that there is a higher stroke risk amongst RAO patients when compared to a control population without retinovascular disease, at 19.6 to 25% compared to 10.1-14.8% respectively.

Implications for Diabetic Eye screening

The DESP is likely to identify established changes of RAO rather than fresh new events, which as outlined above, are an ocular emergency. Therefore questions to be answered of diabetic patients with changes indicative of a previous RAO on a retinal screen should include:

1) Has the subject been reviewed in an eye department?

2) Has the subject had medical review to identify and appropriate treatment of underlying cause and risk factors?

3) If a smoker, has cessation advice been given?

If no medical or ophthalmological review has been performed, then a local mechanism in each DESP should be in place to ensure appropriate management is undertaken.

Conclusions

Acute central retinal artery occlusion should be considered as an ocular emergency. Retinal artery occlusion is an important cause of sight loss that may be detected in the diabetic retinal screening programmes. A check usually from patient history should determine that there has been ophthalmological and medical assessment, and if not, a referral mechanism for medical review in place in each local programme.

Further reading

• Varma, DD, Cugati, S, Lee, AW, Chen, CS. A review of central retinal artery occlusion: clinical presentation and management. Eye, 2013; 27(6): 688-698

• Dodson PM, Gibson JM and Kritzinger EE. Clinical Retinopathies published by Chapman and Hall 1995. Chapter 7 retinal Artery Occlusion: 77 – 83

• Hankey GJ,Slattery JM and Warlow CP Prognosis and prognostic factors for retinal infarction; a prospective cohort study. Brit Med J 302:499 – 504 (1991)

• Chang Y-S, Jan R-L, Weng S-F, Wang J-J, Chio C-C, Wei F-T, et al..Retinal artery occlusion and the 3-year risk of stroke in Taiwan: a nationwide population-based study. Jpn J Ophthalmology 154(4): 645-652 (2012)

• Woo SCY, Lip GYH, Lip PL. Associations of retinal artery occlusion and retinal vein occlusion to mortality, stroke, and myocardial infarction: a systematic review. Eye 30:1031 – 1038 (2016)