Acetazolamide, alternate carbonic anhydrase inhibitors and hypoglycaemic agents: comparing enzymatic with diuresis induced metabolic acidosis following intraocular surgery in diabetes

We describe a case of acetazolamide induced acidosis associated with the precipitation of a hyperosmolar state in a diabetic patient 6 weeks after routine phacoemulsification. While renal tubular acidosis is well reported with acetazolamide, this case suggests that a direct diuresis induced acidosis can also have significant effects, producing serious complications when acetazolamide is prescribed to a diabetic patient, and those with renal impairment, with important implications for prescribing.

Case report

A 47 year old female patient underwent technically uncomplicated left phacoemulsification with intraocular lens implant in 2002. Medical history included insulin dependent diabetes since 1971. She had treated, stable proliferative diabetic retinopathy, relatively mild diabetic nephropathy (proteinuria with a stable creatinine in the region of 140 μmol/l for several months), and mild diabetic autonomic neuropathy. Serum urea had been slightly raised in the past, though had normalised. Serum electrolytes were also within normal limits. The patient was compliant with instructions and blood glucose had been well controlled over many years with regular subcutaneous insulin, no episodes of ketoacidosis or a non-ketotic hyperosmolar state.

Six weeks after cataract surgery she developed left cystoid macular oedema. Confirmed by fundus fluorescein angiography, treatment was started with topical ketorolac and frequency of postoperative topical steroid increased. Treatment was later started with acetazolamide 250 mg orally twice a day, with instructions to drink lots of sugar free fluids to compensate for the diuretic effect. Arrangements were made for regular monitoring of her electrolyte status.

The patient started to progressively deteriorate over the next few days, reporting a massive diuresis. She required emergency admission 6 days after starting treatment. Biochemical results are shown in table 1. Subcutaneous insulin was administered and acetazolamide discontinued. A sliding scale of insulin and intravenous saline drip were commenced on admission. Full blood count was normal, with no evidence of neutrophilia. Arterial blood gas analysis is shown in table 2. This shows that she had a metabolic acidosis. Arterial blood pH 7.3 after initial resuscitation implies that she was even more acidic before fluid resuscitation. The hyperglycaemia, absence of ketones, and raised osmolality led to the diagnosis of hyperglycaemic hyperosmolar non-ketotic syndrome (HONK).

The patient stabilised rapidly overnight, with normal blood gases, blood glucose, and an improving serum creatinine of 141 μmol/l by the next day. A sliding scale was discontinued 2 days following admission, when she was recommenced on a subcutaneous insulin regimen and discharged as an inpatient.

Comment

This case suggests that the diuretic induced mechanism for acetazolamide acidosis can be a cause of severe metabolic acidosis in susceptible patients, and that the diuresis can be severe enough to precipitate a life threatening diabetic crisis. Carbonic anhydrase inhibitors such as acetazolamide affect the metabolism of carbonic acid, bicarbonate, and carbon dioxide within the proximal tubule cell, inducing a slight diuresis. It is rare for severe metabolic acidosis to develop outside advanced renal failure, chronic diarrrhea, in the elderly and those on nephrotoxic drugs.8 While the patient’s renal impairment was only moderate with serum creatinine at 140 μmol/l, when acutely unwell it approached 150 μmol/l, a level which would have necessitated referral to a renal specialist to plan end stage renal replacement therapy.9 This is because patients with diabetic nephropathy tend to do less well than those with other causes of renal impairment and, in fact, renal dialysis may in any case be required at relatively low levels of creatinine such as less than 200 μmol/l.

Most reports in the literature do not specify the underlying pathophysiological mechanism causing metabolic acidosis with acetazolamide. Some cases have been suspected to be the result of a biochemical effect operating at an enzymatic level to increase urinary loss of bicarbonate producing a metabolic acidosis— for example, renal tubular acidosis, and potentially also lactic acidosis, damage to the tricarboxylic acid cycle, ketosis and inhibition of pyruvate carboxylase.10,11 However, the biochemical results in this patient, together with the rapidity of acidosis, do not suggest a tubular origin for the acidosis.10 Instead the patient displayed an alternative mechanism that accounts for the metabolic acidosis. This was causing the physiological effect of diuresis causing loss of excess body water in a diabetic patient. Further, there was no history of biguanide use; metformin is an oral hypoglycaemic agent that can cause lactic acidosis to the extent that it is contraindicated with a creatinine level of 150 μmol/l or more. Basic physiological work suggests that a diuresis induced acidosis can be a significant factor with acetazolamide.12 Biochemical results in this patient directly correspond to those obtained when healthy subjects have been given three 250 mg doses of acetazolamide.13 Acute clinical doses of the drug cause a change in body fluid compartments leading to a moderate isosmotic hypovolaemia with an intracellular volume expansion as well as metabolic acidosis.13 Three 250 mg doses of acetazolamide in healthy men are associated with a significant 1.7 litres reduction in body water, compartmentalised as a significant reduction in extracellular water and increase in intracellular water.13 In this patient such a diuresis would have been significant enough when occurring over a few days to produce enough loss of body water to precipitate dehydration and lactic acidosis despite her drinking large volumes of fluids. Physiological stress of this nature is a well known stimulus that can precipitate a diabetic crisis in a susceptible patient, the massive rise in blood glucose largely accounting for the high osmolality in the patient. Hyperglycaemic hyperosmolar non-ketotic syndrome (HONK) does occur, although less commonly than ketoacidosis in insulin dependent diabetics. This makes plausible the postulate that acetazolamide was the culprit. Theoretically, a diabetic ketoacidosis is also possible, though we are unaware of specific reports to date in this context. HONK is arbitrarily defined as serum osmolality >320 mOsm/kg and a blood glucose level >33 mmol/l, without excessive ketones, and

Table 1 Biochemistry on admission

<table>
<thead>
<tr>
<th>Serum glucose</th>
<th>Serum Na+</th>
<th>Serum K+</th>
<th>Serum urea</th>
<th>Serum creatinine</th>
<th>Urine ketones*</th>
<th>Serum osmolality†</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 mmol/l</td>
<td>135 mmol/l</td>
<td>4.0 mmol/l</td>
<td>14.1 mmol/l</td>
<td>149 μmol/l</td>
<td>0</td>
<td>357 mOsm/kg</td>
</tr>
<tr>
<td>3–6 mmol/l</td>
<td>135–145 mmol/l</td>
<td>3.5–5.0 mmol/l</td>
<td>16–20 mmol/l</td>
<td>60–120 μmol/l</td>
<td>330 mOsm/kg</td>
<td></td>
</tr>
</tbody>
</table>

*Normally no ketones are detected on stick testing of urine.
†([Na+–K+]+urea)glucose, using serum concentrations; dangerous if outside 240–330 mOsm/kg.
was clearly induced by the stress of diuresis in this patient, with which it is associated. It would also have compounded the patient’s existing dehydration. Mortality from HONK can be as high as 40\% despite hospital admission.\footnote{Zaidi PH, Kinnear PE. Acetazolamide is contraindicated in renal dysfunction, and hyperchloraemic acidosis. British National Formulary 1998.}

It is possible that the precise mechanism of metabolic acidosis seems not to have been considered in most case reports as treatment was, in many ways, unaffectected. Alternatively, it may be that the effect reported in this case is extremely rare. However, the clinical findings in this case are supported directly by correlation with the findings of basic physiological work on the pharmacodynamics of acetazolamide, together with work on the pathophysiology of HONK.\footnote{Zaidi PH, Kinnear PE. Acetazolamide is contraindicated in renal dysfunction, and hyperchloraemic acidosis. British National Formulary 1998.} This suggests that the observations made on this case are certainly of much broader significance and raise an issue of concern about the drug’s prescription in both diabetes and renal failure. While manufacturer’s recommendations for acetazolamide in Britain include contraindications to its use in supraphenal dysfunction, they do not issue cautions for its use in diabetes. Thus this case’s principal value lies in evaluating current prescribing practice, particularly as diabetics are a very common group of patients in ophthalmic practice, and acetazolamide is not uncommonly prescribed in many different areas of clinical ophthalmology, as well as by other clinicians. Until further data are forthcoming, including data on newer slow release formulations, good practice should be to prescribe the drug with special caution in diabetics, particularly for those conditions, including this case, where its prescription is not routine. In the context of its use in diabetes it is also certainly worth comparing acetazolamide with other carbonic anhydrase inhibitors. One of the other carbonic anhydrase inhibitors that have been used in clinical ophthalmology is methazolamide. The latter is associated with a less profound reduction in intracocular pressure, but also less acidosis.\footnote{Zaidi PH, Kinnear PE. Acetazolamide is contraindicated in renal dysfunction, and hyperchloraemic acidosis. British National Formulary 1998.}

This case should also serve as a reminder that patients with any level of renal impairment are a group that are vulnerable to acetazolamide toxicity. The data sheet and electronic medicines compendiums state that acetazolamide is contraindicated in marked kidney and liver dysfunction, supraphenal gland failure, and hyperchloraemic acidosis. The British National Formulary is less specific and states that it is contraindicated in renal impairment. We would suggest that diabetic patients with a creatinine level of 140 mmol/l are at quite high risk of nephrotoxic drug reactions, though caution should be exercised in even mild renal impairment.

<table>
<thead>
<tr>
<th>Patient</th>
<th>pH</th>
<th>pCO₂</th>
<th>pO₂</th>
<th>Base deficit (excess)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>7.3</td>
<td>3.4 kPa</td>
<td>15 kPa</td>
<td>-10.3 mmol/l</td>
</tr>
<tr>
<td>Reference range</td>
<td>7.3–7.45*</td>
<td>4.5–6.0 kPa</td>
<td>12–15 kPa</td>
<td></td>
</tr>
</tbody>
</table>

*Life threatening and beyond 7.2 and 7.6.
†Normal <23 mmol/l. ≤−3 mmol/l = metabolic acidosis, >+3 mmol/l = metabolic alkalosis, −3 mmol/l to +3 mmol/l = mild metabolic acidosis, severe metabolic alkalosis, or mixed metabolic disturbance.

Figure 1 (A) ‘Now we are going to shine a very bright light light into your eye’ … and indeed it was bright. The light pulsed gently and sparkled at the edges where the heavenly blue began. (B) It was outshone by an even brighter light … more pulsations and shimmers of an intense whiteness followed and two glowing red circles appeared, the lower one seeming to be a secondary image or reflection of the upper one.

under local anaesthesia might also experience visual symptoms. We present illustrations and comments (figs 1–4) made by an artist who underwent retinal detachment surgery. He presented with macula-on retinal detachment successfully repaired by vitrectomy, cryotherapy, and 20\% SF6 gas performed by peribulbar anaesthesia. They provide an interesting insight into previously unreported visual experience during vitreoretinal surgery. As visual symptoms are both common, and may be perceived to be frightening in a small percentage of patients,\footnote{Zaidi PH, Kinnear PE. Acetazolamide is contraindicated in renal dysfunction, and hyperchloraemic acidosis. British National Formulary 1998.} we reinforce the view that informed patient consent procedures should include the possibility of visual experience during vitreoretinal surgery under local anaesthesia.

The art of retinal detachment surgery: a photoessay

Subjective visual experience has been described previously in patients undergoing intraocular surgery, and may occur during either topical anaesthesia or regional anaesthesia (peribulbar, retrobulbar, subtenons).\footnote{Zaidi PH, Kinnear PE. Acetazolamide is contraindicated in renal dysfunction, and hyperchloraemic acidosis. British National Formulary 1998.} Published reports suggest most or all patients undergoing cataract extraction under local anaesthesia will report some visual symptoms when questioned immediately after their procedures. These symptoms are common therefore and range from perception of light, photopsia, colours, and movement, through to more formed visual sensations such as patterns, instruments, and surgeon’s fingers/hands/detail. It is not surprising that patients undergoing vitreoretinal surgery

Table 2 Arterial blood gases on admission

<table>
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References


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References


Apolipoprotein E polymorphism in patients with cataract

Based on similarities in epidemiology and biochemistry, it has been suggested that cataract and Alzheimer’s disease (AD) share the same aetiological mechanisms. Comorbidity of cataract and AD in trisomy 21 (Down’s syndrome) is well known and both diseases are characterised by aggregated proteins exhibiting excessive glycation and racemisation of aspartyl residues. Several AD
related proteins—amyloid precursor protein (APP), β amyloid (Aβ), and presenilin (PS)—are expressed in the lens and Aβ is accumulated in the cytosol of lens fibres in cataractous lenses of people with AD.

Human apolipoprotein E (apoE) exists in three major isoforms encoded by distinct alleles (APOE ε2, ε3, and ε4). The different APOE alleles have been studied in relation to several human age related diseases: inheritance of the ε4 allele is a strong risk factor for AD and influences Aβ metabolism. The purpose of this study was to investigate the APOE ε2/ε3/ε4 polymorphism in patients with cataract.

After informed consent, patients with senile cataract and control individuals were recruited from two ophthalmic clinics in Tartu and the south Estonian area. The study was approved by the ethics committee at the University of Tartu, Estonia. Before surgery, the type of cataract was determined using biomicroscopy and ophthalmoscopy. Secondary cataracts were excluded. The case group included 502 patients; 77 with nuclear, 155 with cortical, 119 with posterior subcapsular, and 151 with mixed opacities. Mean age was 72.0 (SD 8.7) years (range 43–93 years) and 348 (69.3%) were women. The control group consisted of 187 individuals without cataract, uveitis, or glaucoma. Mean age was 65.8 (SD 6.9) years (range 43–93 years) and 155 (67.2%) were women. The power of the study was >99% as calculated according to Altman’s on the basis of APOE ε4 allele frequencies in a recent study on AD. The APOE alleles and genotypes were determined as previously described. The allele and genotype frequencies of cataract cases and controls were compared using a two tailed Fisher’s exact test, and odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. All statistical analyses were performed using STATIST as software (SPSS Inc, Chicago, IL, USA). Statistical significance was defined as p<0.05.

APOE allele and genotype frequencies found in this study are well in accordance with those reported in other Northern European populations. No significant differences were seen between the control and cataract groups for any of the APOE alleles (table 1) or APOE genotypes (table 2). Neither were there any differences between the control group and the specific cataract subgroups. In order to prevent the data from being influenced by age differences between the groups studied, age matched control individuals were selected and compared with the cataract group and vice versa, without resulting in any significant changes in APOE allele or genotype frequencies.

Alzheimer’s disease and cataract both exhibit large aggregates of aberrant proteins, senile plaques composed of Aβ and neurofibrillary tangles containing the cytoskeletal protein tau in the former case, and light scattering high molecular weight aggregates of crystallins in the latter. Together with several other diseases characterised by protein aggregates, such as amyloidosis and prion diseases, the term “conformational disease” has been created, suggesting a common aetiology.

The APOE ε4 allele is a strong risk factor for AD, and it is believed that in neuronal tissue, apoE is important for mobilisation and redistribution of lipids, and for maintenance and repair of neuronal cell membranes. However, in age related macular degeneration (AMD)—a condition characterised by accumulation of extracellular deposits termed drusen, containing among other things neutral lipids, cholesterol, and apoE—the ε4 allele appears to confer protection, whereas the ε2 allele is associated with a moderately increased risk of AMD. The APOE ε4 allele also seems to play a protective role during embryogenesis, suggesting different effects of the gene early and late in life. To our knowledge, this is the first study to investigate the APOE polymorphism in cataract patients. No differences in the distribution of APOE alleles and genotypes could be seen between controls and cataract patients in spite of a large number of participants and a very high power. This indicates that if there is a common pathogenic mechanism for cataract and AD, it does not involve the

<table>
<thead>
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<th>Table 1</th>
<th>APOE allele frequencies for control and cataract groups</th>
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<tbody>
<tr>
<td>APOE allele</td>
<td>Controls (n = 374)</td>
</tr>
<tr>
<td>ε2</td>
<td>0.112</td>
</tr>
<tr>
<td>ε3</td>
<td>0.773</td>
</tr>
<tr>
<td>ε4</td>
<td>0.115</td>
</tr>
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</table>

n, number of alleles. *p<0.05 for all alleles when comparing controls and cataracts (all cases) or cataract subgroups. 95% confidence intervals of all odds ratios included 1.0 (no difference).

<table>
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<tr>
<th>Table 2</th>
<th>APOE genotype distributions for control and cataract groups</th>
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<tbody>
<tr>
<td>APOE genotype</td>
<td>Controls (n = 187)</td>
</tr>
<tr>
<td>ε2/ε2</td>
<td>0.011</td>
</tr>
<tr>
<td>ε2/ε3</td>
<td>0.182</td>
</tr>
<tr>
<td>ε2/ε4</td>
<td>0.002</td>
</tr>
<tr>
<td>ε3/ε3</td>
<td>0.588</td>
</tr>
<tr>
<td>ε3/ε4</td>
<td>0.187</td>
</tr>
<tr>
<td>ε4/ε4</td>
<td>0.011</td>
</tr>
</tbody>
</table>

p<0.05 for all genotypes when comparing controls and cataracts (all cases) or cataract subgroups. 95% confidence intervals of all odds ratios included 1.0 (no difference). NO, not observed.

Figure 4  (A) Considerable time has now elapsed and the gas bubble has diminished a great deal. This is my view of it with the eye closed and in strong sunlight. (B) This illustrates still further diminution of the bubble and its detachment from the edge of the field of vision. (C) Eventually the gas bubble became miniscule, and reversed its position in the visual field of vision before disappearing altogether.
Mitomycin C in sebaceous gland carcinoma with pagetoid spread

Sebaceous gland carcinoma is a rare eyelid tumour comprising less than 1% of all eyelid malignancies.¹ It commonly arises from the meibomian glands of the tarsus, but may also arise from the glands of Zeis or from the sebaceous glands of caruncle.² It can present in a nodular or diffuse indurative form. The latter form with intraepithelial (pagetoid) invasion has poor prognosis as a result of delay in diagnosis as well as more extensive involvement of ocular tissues. Topical application of mitomycin C, a non-cell cycle specific alkylating agent, has been advocated for Pagetoid spread of sebaceous gland carcinoma.³ We report the use of mitomycin C as adjuvant therapy in a patient with completely excised sebaceous gland carcinoma and pagetoid spread.

Case report

A 78 year old man was referred to the oculoplastic clinic with epiphora and irritation of right eye for 2 years. There was no previous ocular or medical history. Clinically he had a unilateral right upper lid entropion with tarso-conjunctival entropisation (fig 1) and bilateral dermatochalasis. The patient underwent bilateral blepharoplasty and biopsy of right upper lid tarsal plate and conjunctiva. The biopsy confirmed sebaceous gland carcinoma with pagetoid invasion of the conjunctival epithelium (fig 2). He had a full thickness wedge excision of the right upper lid with tarsocutaneous biopsies. These showed sebaceous gland carcinoma to the margin of the excision with Pagetoid invasion of the conjunctiva and epidermis of the lid margin. A wider excision of the lid and further conjunctival biopsies were performed with frozen section revealing complete excision of the tumour. Reconstruction of the posterior lamella was achieved using a hard palate graft and the anterior lamella was repaired by a myocutaneous flap with post auricular skin graft and a bilobed flap medially.

Conjunctival map biopsies were clear of tumour 1 and 6 months post excision. In view of pagetoid spread, the patient was commenced on three cycles of topical mitomycin C 0.02% four times a day. Each cycle consisted of 2 weeks of mitomycin C and 2 weeks off therapy. Corneal epithelial toxicity and ulceration was noted with mitomycin C therapy, requiring preservative free lubricants and lateral tarsorrhaphy. Two years after excision of tumour, the patient remains disease free.

Comment

Intraepithelial invasion in sebaceous gland carcinoma is noted to occur in 41–80% of cases.⁴ Diagnosis may be delayed as the presenting symptoms are often benign and non-specific such as blepharoconjunctivitis. Diagnosis requires biopsy of the abnormal area and conjunctival map biopsies in the presence of intraepithelial invasion.⁵ Various treatments have been used for Pagetoid invasion including surgical excision with cryotherapy, external beam radiotherapy, and orbital exenteration.⁶ Eyes with Pagetoid invasion are more likely to undergo exenteration.⁶

In our case the suspicion of malignancy was raised because of the unilaterality of the clinical features. Our patient underwent extensive excision of the tumour with tumour free conjunctival biopsies. Mitomycin C as adjuvant treatment was commenced as a result of the difficulty in clinically assessing for recurrence with page-toid invasion. Mitomycin C was associated with moderate epithelial toxicity which was self limiting. Mitomycin C is a non-cell cycle specific alkylating agent which acts to inhibit cell proliferation, and is used successfully in the treatment of corneal intraepithelial neoplasia.⁶ This is only the second reported article where mitomycin C has been used in the

Figure 1 Upper lid tarso-conjunctival scarring.

Figure 2 Conjunctival biopsy demonstrating intraepithelial invasion of malignant cells.
treatment of sebaceous gland carcinoma. In the pilot study by Shields et al., there was complete resolution of tumour with no recurrences over 12 month follow up. Mitomycin C as adjuvant treatment in a paper spread of sebaceous gland carcinoma may reduce the need for more invasive treatment options.

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References

A questionnaire survey of patient acceptability of optic disc imaging by HRT II and GDx

Glaucoma is an insidious condition which remains asymptomatic until very advanced with nerve damage occurring before detectable visual field loss.1 Early detection and treatment result in a better prognosis with retardation of progression.2

The Heidelberg retinal tomograph (HRT II) (Heidelberg Engineering, Germany) and the GDx Nerve fibre analyser (Laser Diagnostic Technologies Inc, San Diego, CA, USA) are instruments which use scanning laser technology to diagnose and monitor the progression of glaucoma.

We conducted a questionnaire survey of subjects undergoing imaging by these methods in a primary care setting to compare patient acceptability of the two tests.

Methods

Seventy new patients referred with a possible diagnosis of glaucoma were asked to complete a questionnaire about their experience of optic disc imaging. Informed consent was obtained and the study had approval from the Moorfields Eye Hospital research and ethics committee. None of the subjects had undergone disc imaging previously. Subjects underwent sequential disc imaging by experienced technicians using HRT II then GDx or vice versa in approximately equal numbers. Only subjects who had vision of at least 6/12 and who had successful imaging by both methods were included.

The questionnaires consisted of two identical sets of six direct questions using a 14 font (Appendix 1). Questionnaires were completed immediately after imaging to reduce the potential for recall bias. Statistical significance was determined using McNemar’s tests.

Results

Sixty seven questionnaires were completed. Demographic and diagnostic data are shown in table 1 and patient responses in table 2. The majority of patients found both tests agreeable with regards to each characteristic under study other than chin rest comfort. Sixteen patients found the HRT II chin rest uncomfortable, two (25%) said that it was more comfortable, and six of the 31 (19%) said that it was easier to perform the test. Four of the eight subjects (50%) who chose GDx did so because it was easier, two (25%) said that it was more comfortable and 21% did not give a reason.

Comment

Diagnostic and screening tests should be safe, specific, sensitive, and acceptable to patients. The HRT and GDx have cited sensitivities of 0.42–0.88 and 0.64–0.96 and specificities of 0.84–0.90 and 0.74–0.96 respectively.3

Most patient found both tests to be fairly acceptable. Twenty eight (42%) subjects stated no preference but of those who did, a significant proportion of patients preferred HRT II over GDx. The most common reason given was a shorter test duration implying that acquisition time may have an impact on acceptability. Examination with the GDx may be longer because of the external fixation target, which a greater proportion of subjects found difficult to focus on. In contrast, the HRT II has an internal fixation target.

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<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic and diagnostic data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic features</strong></td>
<td><strong>n = 67</strong></td>
</tr>
<tr>
<td>Male</td>
<td>34 (50.7%)</td>
</tr>
<tr>
<td>Female</td>
<td>33 (49.3%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>Mean 57.1, SD 14.3, range 18–85</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
</tr>
<tr>
<td>Primary open angle glaucoma</td>
<td>12 (18%)</td>
</tr>
<tr>
<td>Glaucoma suspect</td>
<td>18 (27%)</td>
</tr>
<tr>
<td>Ocular hypertension</td>
<td>16 (24%)</td>
</tr>
<tr>
<td>Non-glaucomatous optic neuropathy</td>
<td>3 (4.5%)</td>
</tr>
<tr>
<td>Normal</td>
<td>15 (22%)</td>
</tr>
<tr>
<td>No diagnosis given</td>
<td>3 (4.5%)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Patient responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>p Value (McNemar’s)</td>
</tr>
<tr>
<td>1. Was the test comfortable? (n = 65)</td>
<td>HRT 0.0003</td>
</tr>
<tr>
<td>GDX Yes No</td>
<td>46 16 2</td>
</tr>
<tr>
<td>2. Was the light too bright? (n = 58)</td>
<td>HRT 0.3877</td>
</tr>
<tr>
<td>GDX Yes No</td>
<td>26 19 12</td>
</tr>
<tr>
<td>3. Was the chin rest uncomfortable? (n = 65)</td>
<td>HRT 0.0522</td>
</tr>
<tr>
<td>GDX Yes No</td>
<td>26 26 8 12</td>
</tr>
<tr>
<td>4. Was the test too long? (n = 65)</td>
<td>HRT 0.0039</td>
</tr>
<tr>
<td>GDX Yes No</td>
<td>1 9 19 55</td>
</tr>
<tr>
<td>5. Did you have trouble keeping your eye still? (n = 65)</td>
<td>HRT 0.0009</td>
</tr>
<tr>
<td>GDX Yes No</td>
<td>14 29</td>
</tr>
</tbody>
</table>

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Although the HRT II was found to be a more comfortable test, a higher proportion found the HRT II chintest to be uncomfortable possibly because of the forward sloping angulation.

We did not correlate patient preference with image acquisition time. More open questions may have helped to find the reasons for certain preferences. We were unable to determine the strength of preference from the collected data. Our study was also not randomised but roughly equal numbers had either HRT II or GDx first. We do not feel that there was a significant order effect. As our patients were new referrals, their responses were not biased by familiarity with previous tests. Patients underwent both tests sequentially on the same day by trained technicians reducing the likelihood of prolonged acquisition time due to inexperienced operators. All patients had good vision so locating the target was not an issue. Additional work examining the factors which affect acquisition time (for example, refractive error, presence of media opacity, pupil size) is needed to further understand patient preference.

It is uncertain if the differences in preference between the two tests will have a significant impact on patient satisfaction and compliance with clinic visits as a whole. Other factors, such as waiting time and comfort of waiting room, will have to be examined as well.

In conclusion, our study highlights the importance of both test characteristics and comfort in instrument design. It is hoped that manufacturers take into account these factors in the design of the next generation of glaucoma imaging devices.

**Appendix 1**

The questions were:

1. Was the test comfortable? Yes or No?
2. Was the light too bright? Yes or No?
3. Was the test uncomfortable? Yes or No?
4. Was the test too long? Yes or No?
5. Did you have trouble keeping your eye still? Yes or No?
6. (a) Which test did you prefer? HRT or GDx? (b) Why?

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**References**


**A novel mutation in the alternative splice region of the PAX6 gene in a patient with Peters’ anomaly**

The PAX6 gene is involved in ocular embryogenesis. This gene seems to be the master control gene for morphogenesis of the eye. Mutations in the PAX6 gene have been detected in various ocular anomalies suspected to have bilateral genetic backgrounds during development, including aniridia, Peters’ anomaly, and foveal hypoplasia.  

In 1994, a sporadic case of Peters’ anomaly and a small family with a range of anterior segment malformations including Peters’ anomaly, were shown to have a mutation of the PAX6 gene. More recently, Azuma et al. reported a subject with Peters’ anomaly having a missense mutation in the alternative splice region of the PAX6 gene in 1999. Here we report a novel PAX6 gene mutation in a patient with Peters’ anomaly.

![Figure 1](image-url)  
*Photographs show the anterior segment region. (A) The anterior segment of the patient. She had bilateral Peters’ anomaly and showed corneal opacity with iridocorneal adhesion and nystagmus. The best corrected visual acuity was 20/100 (right) and 20/200 (left). The fundus of both eyes could not be seen because of corneal opacity. (B) The anterior segment of patient’s father. (C) The anterior segment of patient’s mother. (D) The anterior segment of patient’s elder brother. No congenital ocular abnormalities of anterior segment region were found in her parents or elder brother.*
However, no mutation was found in her parents or elder brother. (B) Direct sequencing of PAX6 PCR product from the patient with Peters anomaly indicated that they do not have the same mutation.

Figure 2 (A) Pedigree of the patient (arrow). All of the members represented here were examined. Solid symbol indicates Peters’ anomaly and open symbols indicate normal phenotype. Sequence analysis revealed a heterozygous mutation in the alternative splicing region in the patient. However, no mutation was found in her parents or elder brother. (B-1) Electropherogram of forward sequence of PAX6 exon 5a. (B-2) Electropherogram of reverse sequence of PAX6 exon 5a. (C) The result of SNaPshot method. (C-1) The patient represents double peaks with green corresponding to A and blue corresponding to G, indicating heterozygous mutation at the base position of 38 which is consistent with sequencing results. (C-2) Normal subjects represent a single peak corresponding to A indicating no mutation at the position. (D) Direct sequencing of PAX6 PCR product from the patient’s relatives indicates that they do not have the same mutation.

References

Tuberculous intraocular infection presenting with pigmented hypopyon: a clinicopathological case report

Tuberculosis still remains a major cause of morbidity and mortality globally. The incidence of tuberculosis is increasing by eight million new cases annually and is a cause of death for two to three million patients every year. The ocular manifestations of tuberculosis are diverse, and depend on the immunological, bacteriological, and epidemiological variables. Individuals with compromised immune status usually present with atypical presentations. This clinicopathological report of a patient treated with immunosuppressive agents shows intraocular tuberculosis presenting with pigmented hypopyon.

A 38 year old female patient with a history of polyarthralgia, anaemia, hypertension, and an impaired renal function with a possible clinical diagnosis of systemic lupus nephropathy underwent renal biopsy, which disclosed membranous glomerulonephropathy with peripheral granular deposits of IgG, C3, and IgM on immunofluorescence. Her erythrocyte sedimentation rate was elevated (74 mm in the first hour) and she had positive antinuclear antibody; negative rheumatoid factor, VDRL, HIV, and tuberculin skin test (PPD). She was treated with intravenous cyclophosphamide 1 g per day once every month for 3 months and corticosteroids 30 mg/day. At the time of the third intravenous injection of cyclophosphamide, she noticed deterioration of vision in the right eye. On examination, right eye visual acuity was 6/6 and hand movements close to face. The conjunctiva was congested and the cornea was oedematous. The anterior chamber was shallow, and a 3 mm pigmented hypopyon was noted (fig 1). The left eye was unremarkable and the vision was 6/6. Blood and urinalysis showed no growth, and smears of anterior chamber fluid were negative for bacteria and fungi. Oral ciprofloxcin (500 mg twice per day) was started in addition to topical corticosteroids and mydriatics. A week later, the pigmented hypopyon had increased to 5 mm; it was aspirated and submitted for cultures and staining. Ziehl-Nielsen’s stain revealed several acid fast bacilli (AFB). The culture was positive for AFB and the Tuberculosis Research Centre in Chennai, India, identified the organisms as Mycobacterium tuberculosis based on pigment production, positive niacin, and catalase test. The patient was re-examined for evidence of systemic tuberculosis. Her PPD was negative and there were no radiological or clinical evidence of extraocular tuberculosis. Despite treatment with four antituberculosis drugs (rifampicin 450 mg, isoniazid 300 mg, ethambutol 800 mg, and pyrazinamide 1500 mg), and oral steroids (20 mg) for her polyarthralgia, the patient developed multiple scleral abscesses and lost the remaining vision. She underwent enucleation of the right eye and was continued on antituberculous agents for 6 months. She was continued on tapering dose of systemic corticosteroids for 3 months following a fourth intravenous cyclophosphamide injection. She was followed for two more years and there were no signs of disseminated tuberculosis during that time.
in the deep corneal stroma and in the anterior chamber exudates. Evaluation did not disclose extraocular focus. The cause of dark hypopyon in the endophthalmitis cases was assumed to be a dispersion of melanin from the necrotic iris. This may also show necrotic iris and dispersed melanin granules in the anterior chamber, suggesting a common underlying pathology for the formation of pigmented hypopyon. To the best of our knowledge this is the first known case of pigmented hypopyon in a biopsy and culture proved intraocular tuberculosis, and highlights the need for anterior chamber fluid analysis in arriving at the diagnosis.

The clinical spectrum of ocular tuberculosis infection includes chronic uveitis, interstitial keratitis, scleritis, sclerouveitis, optic neuritis, choroiditis, retinitis, chorioretinitis, and panophthalmitis. Hypopyon is rarely noted in tuberculosis. 

Histopathological examination of the enucleated eye showed infiltration of acute inflammatory cells and macrophages in the posterior half of the corneal stroma (fig 2). The anterior chamber was filled with pigment containing necrotic cells, macrophages, and proteinaceous exudate. The iris and ciliary body were necrotic and were infiltrated by pigment laden histiocytes. The sclera revealed necrosis with infiltration of acute inflammatory cells. The vitreous cavity contained proteinaceous exudate without significant inflammatory cell infiltration. Acid fast stains disclosed an abundance of AFB deep in the inflammatory cell infiltration. Acid fast stains disclosed an abundance of AFB deep in the inflammatory cell infiltration. Acid fast stains disclosed an abundance of AFB deep in the inflammatory cell infiltration. Acid fast stains disclosed an abundance of AFB deep in the inflammatory cell infiltration.

Histopathological diagnosis was tuberculous necrotising keratouveitis.

**Comment**

In this case, the pigmented hypopyon was made up of melanophages. Darkly pigmented hypopyon may appear in eyes harbouring necrotic uveal melanomas in endogenous endophthalmitis caused by *Listeria monocytogenes* and *Serratia marcescens.* The cause of dark hypopyon in the endophthalmitis cases was assumed to be a dispersion of melanin from the necrotic iris. This may also show necrotic iris and dispersed melanin granules in the anterior chamber, suggesting a common underlying pathology for the formation of pigmented hypopyon. To the best of our knowledge this is the first known case of pigmented hypopyon in a biopsy and culture proved intraocular tuberculosis, and highlights the need for anterior chamber fluid analysis in arriving at the diagnosis.

The clinical spectrum of ocular tuberculosis infection includes chronic uveitis, interstitial keratitis, scleritis, sclerouveitis, optic neuritis, choroiditis, retinitis, chorioretinitis, and panophthalmitis. Hypopyon is rarely noted in tuberculosis. Hypopyon may appear in rifabutin treated patients who had *Mycobacterium avium* complex infection. In all instances, the hypopyon was not darkly pigmented. The clinical and histopathological features suggest that the ocular infection could be endogenous; however, systemic evaluation did not disclose extraocular focus. The presence of large numbers of acid fast organisms in the histological sections suggests that the organisms could be atypical mycobacteria. However, the cultures showed that the organisms were *Mycobacterium tuberculosis.* Presence of such large numbers of the organisms in the ocular tissue could be from treatment induced immunosuppression.

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**References**

Trypan blue: authors' reply

We would like to thank Dr Rodrigues and colleagues for bringing up this interesting point of what exactly trypan blue stains.1

In our study, immunohistochemistry was performed to determine the nature of cells involved in the epiretinal membranes (ERM)—not to determine the presence or absence of the ERM. Presence or absence of ERM was determined by examining routinely stained sections (haematoxylin and cosin, periodic acid Schiff) for cytoplasm/nuclei of epiretinal cell elements. All four of the macular hole internal limiting membrane (ILM) specimens were examined in this way. Furthermore trypan blue (in low concentrations) stains the anterior lens capsule. Since this capsule lacks glia, we do not believe that the evidence supports the contention of the correspondents that the staining of our ILM specimens is due to undetected “glial cell elements of the highly cellular ERM” rather than ILM.

Clinically two features are observed with the use of trypan blue. Firstly, the whole posterior pole that comes into contact with trypan blue is stained a faint blue in all cases. The staining pattern is diffuse and not patchy, suggesting trypan blue staining is indiscriminate of ERM or ILM. Secondly, in cases of macular pucker, the trypan blue stained ERM can be removed separately, leaving intact ILM behind, which can be further stained and removed. In cases of macular hole where a clinical ERM is not present, it appears that only the ILM is stained and peeled. We have harvested these membranes and confirmed that the membranes only consist of ILM and without a secondary ERM.

There is no doubt that trypan blue stains both ERM and ILM. We, however, have no knowledge as to what the structural elements of these membrane that the dye is attached to. We concede that staining of ILM with trypan blue can be variable and sometimes rather faint. Since our publication, Perrier and Sebag have also reported their experience with trypan blue in staining ILM and ERM.2 Although histological findings were not given in these studies, clinically the authors found the dye to be useful in both types of membranes. Given the many concerns regarding the use of indocyanine green,1 we believe it is a positive development that an alternative clinically useful dye is available.

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References

Comment
Most outer leaf breaks develop well within the confines of a retinoschisis, and cyst fluid separates the RPE and outer leaf only in the immediate vicinity of the breaks.3 However, the giant outer leaf breaks responsible for the schisis detachments in our patient were each located at the posterior limit of a large retinal cyst. It is unsurprising, therefore, that the detachments progressed beyond the retinoschisis and were symptomatic.

This is the first report of symptomatic schisis detachments that settled without surgery. We agree with Byer1 that the appropriate management for non-progressive schisis detachments is “to do nothing,” and believe this policy can be extended to symptomatic, inferior schisis detachments that do not involve the fovea. Surgical intervention, including retinopexy around the breaks, might well have induced sight threatening complications in our patient1,4,5 while offering no real prospect of a better outcome or prognosis.

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References

Figure 1 Retinal photographs; (A), (C), and (E) are from the right eye in March 2000, November 2001, and October 2002 respectively; (B), (D), and (F) are from the left eye in March 2000, November 2001, and October 2002 respectively.
Charles Bonnet syndrome and bromodine: comments

We read, with great interest, the article published in the BJO by Tomsk et al.1 Interest in the Charles-Bonnet syndrome (CBS) has escalated of late, highlighting the probable 15% incidence of the condition in patients with significant impairment of the visual cortex.2

The authors implied that CBS was induced in four patients by bromidine tartrate on the basis of patient age and the instigation of bromidine therapy, with discontinuation resulting in eventual resolution of the hallucinations. Firstly, the diagnostic criteria proposed by Gold and Rabins3 and Poddell et al.4 quite rightly made no reference to age being indicated as a feature of CBS, although incidence certainly increases with age. Schwartz and Vahige5 found that CBS also occurred in children following profound visual loss. This suggests that the high incidence in the elderly population is possibly attributable to the increased incidence of acquired visual loss occurring with age; therefore, age is not a criterion for diagnosis. Further, although the Snellen acuity of all four patients was <0.1, there is no evidence that visual acuity has been defined as a criterion for diagnosis. Further, although the Snellen acuity of all four patients was <0.1, there is no evidence that visual acuity has been defined as a criterion for diagnosis. Clear sensorium.

CBS.

References


Periocular corticosteroid therapy: comments

I read with great interest the article by Okada et al., reporting the efficacy and complications of trans-Tenon’s retrobulbar infusion of triamcinolone acetonide for posterior uveitic inflammation. The authors have to be commended for the excellent description of this novel technique.

The efficacy of various methods of corticosteroid injection has always been a matter of debate with different studies giving different results. McCartney et al.9 showed that the major route of penetration of steroids after subconjunctival injection was directly through the choroid and retina. In addition, the authors described methods to inject steroids in the sub-Tenon’s space and concluded that the injections should be placed immediately adjacent to the site of intraocular inflammation that was under treatment. In contrast, in a study on rabbit eyes, Wilson et al.10 demonstrated that injection of corticosteroids into the sub-Tenon’s space and the resultant confusion as to whether the unsatisfactory response is secondary to the disease process or failure to inject the steroid into the sub-Tenon’s space or the debated lower efficacy of this route of injection. The procedure is simpler than the described trans-Tenon’s retrobulbar infusion (no special cannula is required), but the risk of endophthalmitis is daunting.11

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References

PostScript


Transcaruncular approach for the management of frontoethmoidal mucoceles: a comment

We read the article by Lai et al1 with interest. The authors report a modification of the non-oblitative external procedure that was first described by Lynch in 1921.2 The Lynch-Howarth procedure3 involved transnasal stenting to prevent medial-ward collapse of the orbit obstructing drainage from the frontal sinus into the nose. Although the transcaruncular procedure uses a different external approach, it nevertheless often involves removal of part of the lamina papyracea for access to the sinuses. Hence, as with the Lynch approach, prolapse of orbital contents into the defect may occur, increasing the risk of re-stenosis. In addition, the cells in the frontal recess are not normally cleared and thus drainage into the nasal cavity is not assured. Stenting of sinus openings results in a significant fibrotic reaction in a proportion of patients, and closure of such a previously stented opening is likely. Furthermore, the follow up period in this study is too short to confirm the success or failure of this technique as recurrence often takes years to manifest.4

Endoscopic management of mucoceles protruding into the other sinuses or nasal cavity has been an accepted treatment for years.5 6 Frontoethmoidal mucoceles are typical of such mucoceles where the bony wall surrounding the mucocele is thin and therefore easily accessible transnasally. The endoscopic procedure creates a large area clear of cells which allows the greatest possible marsupialisation of the mucocele. No stenting is required. Har-El7 reported the largest series of 108 mucoceles with a median follow up of 4.7 years with a recurrence rate of only 0.9%. Therefore, we would recommend an endoscopic approach for frontoethmoidal mucoceles as the integrity of the lamina papyracea is maintained and the largest possible opening is created into the mucocele, which in turn minimises the chances of recurrence.

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2 Lynch RC. The technique of a radical frontal sinus operation which has given me the best results. Laryngoscope 1921; 31: 1–5.


Cataract surgery

The latest issue of Community Eye Health (No 48) discusses a solution to reduce worldwide cataract blindness, including sutureless non-phaco cataract surgery. For further information please contact: Journal of Community Eye Health, International Resource Centre, International Centre for Eye Health, Department of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK (tel: +44 (0)20 7612 7964; email: A Shah@lshtm.ac.uk; website: www.jceh.co.uk). Annual subscription (4 issues) UK£28/US$45. Free to developing country applicants.

Elimination of avoidable blindness

The 56th World Health Assembly (WHA) considered the report on the elimination of avoidable blindness (doc A56/26) and urged Member States to: (1) Commit themselves to supporting the Global Initiative for the Elimination of Avoidable Blindness by setting up a national Vision 2020 plan by 2005; (2) Establish a national coordinating committee for Vision 2020, or a national blindness prevention committee to help implement the plan; (3) Implement the plan by 2007; (4) Include effective monitoring and evaluation of the plan with the aim of showing a reduction in the magnitude of avoidable blindness by 2010; (5) To support the mobilisation of resources for eliminating avoidable blindness. The WHA also urged the Director-General to maintain and strengthen WHO’s collaboration with Member States and the partners of the Global Initiative for the Elimination of Avoidable Blindness as well as aid in the coordination and support of national capability.

XVth Meeting of the International Neuro-Ophthalmology Society


4th International Congress on Autoimmunity

The 4th International Congress on Autoimmunity will take place 3–7 November 2004 in Budapest, Hungary. The deadline for the receipt of abstracts is 20 June 2004. Further details: Kenes International Global Congress Organisers and Association Management Services, 17 Rue du Cendrier, PO Box 1726, CH-1211 Geneva 1, Switzerland (tel: +41 22 908 0488; fax: +41 22 732 2850; email: autoim04@kenes.com; website: www.kenes.com/autoim2004).

XVI International Congress for Eye Research