



Highlights of the 2020
**Moorfields International
Glaucoma Symposium**

January 25-26, 2020,
Royal College of Physicians, London

Meeting chairs:

- . Keith Barton
- . Gus Gazzard
- . Hari Jayaram



SCIENTIFIC PROGRAMME

All sessions from the Moorfields International Glaucoma Symposium 2020 that are summarised in this booklet were also videoed in full. These videos can be found at www.migs.org.uk/gallery/2020/. To access them please use the password MIGStube2020. This password is case sensitive and must be entered as shown.

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SESSION 1: THE OCULAR SURFACE

Science behind the symptoms

Prof Stephen Pflugfelder, Baylor College of Medicine, Houston, TX, USA

- Unique features render the cornea sensitive to pain: exposed surface susceptible to trauma and desiccation, tear instability promotes corneal barrier disruption and nociceptor exposure and dryness increases expression of neurosensitising inflammatory mediators
- There is an evolving understanding of cornea pain
- May become chronic and refractory to conventional therapy
- Target initial therapy to tear dysfunction if tear instability is present
- Platelet rich plasma has been the most effective therapy in our experience

Ocular surface disease in glaucoma patients

Hari Jayaram, Moorfields Eye Hospital, London, UK

- In glaucoma patients, reduced glaucoma-related quality of life (QoL) measures and benzalkonium chloride (BAK) exposure are predictive of ocular surface disease (OSD), the latter more common with increasing severity of glaucoma; OSD is associated with reduced QoL measures and negative impact upon daily activities and daily living
- OSD is important to glaucoma specialists because it leads to poor adherence with medications, has a significant economic burden and a negative impact on surgical outcomes
- Cross-sectional study of glaucoma patients at MEH (n=878 consecutively enrolled) revealed patient reported prevalence (OSDI) of 58% (26% severe); clinician reported measures – blepharitis 60% overall prevalence, tear break up time (TBUT) <10 seconds 50%, abnormal Oxford Grading 29%
- Ongoing and future analyses focused on impact of treatment duration and preservative burden on OSD and health economic analysis of glaucoma pharmacotherapy

Are all drugs created equal?

Prof Miriam Kolko, Copenhagen University Hospital, Rigshospitalet-Glostrup

- The physical properties of generic latanoprost ophthalmic solutions are not identical: force requirements to extract drops; buffer capacity and pH values; viscosity (impacting corneal penetration); and number and size of drops vary significantly; osmolarity of different generic latanoprost formulations also differ (critical factors affecting bioavailability) (Kolko and Jensen Acta Ophthalmol. 2017)
- Overall, generic eye drops should not be considered identical to the original brand version as regards comfort and compliance

- A systematic review and meta-analysis of available evidence found no clinically significant difference in intraocular pressure (IOP)-lowering effect or tolerability between generic prostaglandin analogues (PGAs) and the original formulation, but recommended further research to confirm equivalence. *Steensberg et Ophthalmology Glaucoma. 2020*
- Conjunctival goblet cells (GCs) are essential for maintaining ocular surface homeostasis; PGAs spare the conjunctival GCs more than other antiglaucomatous drops
 - e.g., preservative (BAK) containing latanoprost drops cause GC death
 - preservatives cause and exacerbate OSD, reduce quality of life, reduce adherence and reduce success of glaucoma surgery
 - another dilemma is that preservatives are not equal (e.g., lower OSDI scores for polyquad containing travoprost vs. BAK preserved travoprost), *Suresh et al Rom J Ophthalmol. 2019*
- What's next?
 - Further studies on goblet cells and mucin production
 - Studies on patients to investigate the impact of generics compared to original brand names
 - Further dialogue with health authorities with regard to potentially tighter regulations, 'for the sake of our patients'

Managing the ocular surface before glaucoma surgery

Alex Shortt, University College London Institute of ophthalmology

- Stressed the importance of managing OSD before glaucoma surgery
- Focused on two key areas: improving comfort and compliance (diverting some patients away from surgery) and improving outcomes of those who do have surgery (reduced surgical failure through scarring)
- Recommendations for breaking the OSD cycle pre/post-cataract or glaucoma surgery include: 1) remove preservatives 2) new generation lubricants (sodium hyaluronate 0.1% to 0.3% and sodium hyaluronate plus trehalose), and 3) anti-inflammatory therapy using for example preservative free steroids, ciclosporine, essential fatty acids and doxycycline 100 mg daily for 4 weeks
- Eliminate BAK – switching to preservative free glaucoma drops shown to reduce need for lubricants, improve tear film quality and improve IOP control in combined OSD/glaucoma
- Third-generation lubricants provide bioprotection of the ocular surface, suggested clinicians look for hypotonic formulations and ingredients with evidence for osmoprotection and bioprotection
- Top tips: 'Even to remove BAK is a huge step forward. Add a preservative free steroid prior to surgery. My choice is a topical steroid that doesn't affect IOP. Use a bioprotectant lubricant and tackle meibomian gland expression. I am also a huge advocate of doxycycline, to be taken with food.'

SESSION 2: MICRO TO MACRO – MEDICAL ASPECTS OF GLAUCOMA

OCT in the real world

Prof Donald Hood, Columbia University, USA

- Structure and function provide complementary information
- Maximise image quality during acquisition
- Assess images for segmentation errors and artifacts before looking at the report
- Systematically review the reports, in the context of other data
- Monitor for change
- The art of using OCT is in systematic interpretation'

Meditation: a polypill for comprehensive management of glaucoma patients

Prof Tanuj Dada, RP Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi

- Meditation lowers IOP in glaucoma
- How? Parasympathetic activation, central regulation, increased levels of melatonin, increased trabecular outflow, decreased cortisol
- Meditation induces changes in trabecular meshwork (TM) gene expression in patients with primary open angle glaucoma (POAG) *Dada et al ARVO 2019*

What glaucoma does to you

Prof Pradeep Ramulu, Johns Hopkins Wilmer Eye Institute, Baltimore, MD, USA

- Our work allows people to read, move about and remain active
- Critical to advertise these messages to stakeholders
- And consider what are we doing about those we can't cure

When eyes get hot: evaluation and treatment of uveitic glaucoma, a uveitis specialist's perspective

Prof Gary Holland, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

- Glaucoma/elevated IOP is a common complication of chronic anterior uveitis
- The goal should be prevention of uveitic glaucoma by aggressive suppression of anterior segment inflammation
- Corticosteroid treatment can contribute to control of elevated IOP in selected cases
- The choice of medical or surgical treatments for elevated IOP in patients with uveitis may be different than in patients with age-related chronic open angle glaucoma
- Close monitoring and follow-up is necessary, regardless of the treatment chosen (increased risk of treatment failure)

SESSION 3: TRIALS AND CELEBRATION OF RICHARD WORMALD

The evidence we need for glaucoma surgery in the real and wide world

Winnie Nolan, Moorfields Eye Hospital, London, UK

- Glaucoma is the leading cause of irreversible visual loss and an increasing public health burden in Africa and Asia
- Social deprivation linked to glaucoma blindness
- Treatable and avoidable
- Focus on optimising current care pathways
- Research required into low-cost effective treatment and diagnosis in high-risk populations
- Further RCTs of current medical treatments compared with surgery are required, particularly for people with severe glaucoma and in black ethnic groups – outcomes should include those reported by patients, and economic evaluations are required to inform treatment policy. *Burr et al Cochrane Database Syst Rev. 2012*

New outcome measures

Prof Pradeep Ramulu, Sheila K West Professor of Ophthalmology, Johns Hopkins Wilmer Eye Institute, Baltimore, MD, USA

- There are many levels at which glaucoma outcomes can be assessed
- There are many new opportunities for an interested young researcher
 - Incorporate more detailed domain-specific outcomes into glaucoma treatment trials
 - Better value 'less important' domains – question utility with equal vision presumed?
 - Develop measures to understand treatment success as a path, not a state
- 'We need to think of our treatment as a path, not as a step'

Cochrane Eyes and Vision (CEV), What's next?

Prof Gianni Virgili, University of Florence, Careggi Hospital, Italy

- Where are we now?
 - 20 years of systematic reviewing, with more than 200 eyes and vision systematic reviews on the Cochrane Database of Systematic Reviews, at least half are up to date
 - But one quarter of reviews on important questions about common interventions contain no trials and many more are inconclusive
 - This is often a source of frustration for readers and leads to an expectation that we should include studies of lesser quality
 - However, systematically reviewing unsound evidence simply amplifies error
- Intervention reviews and diagnostic test accuracy (DTA) reviews on OCT are underway that will be used to support the ongoing update of the EGS guidelines (due 2020)

- There have been 4 published reviews of minimally invasive glaucoma surgery (MIGS) procedures to date
- Latest reviewed ab interno trabecular bypass surgery with iStent for OAG, reviewed 7 RCTs *Le et al Cochrane Database Syst Rev. 2019*
- There is currently no high-quality evidence for the effects of subconjunctival draining minimally-invasive glaucoma devices for medically uncontrolled open angle glaucoma *King et al Cochrane Database Syst Rev. 2018*
- Reviews due early in 2020
 - Ab interno supraciliary microstent surgery for open angle glaucoma (number of studies, 1)
 - Ab interno trabecular bypass surgery with Schlemm's canal microstent (Hydrus) for OAG
 - Non-contact methods for the detection of people at risk of primary angle closure glaucoma (PACG)

The long View

Richard Wormald, Moorfields Eye Hospital, London, UK

- CEV has shown what can be achieved with proper analysis of synthesised evidence; reducing uncertainty is key
- Priorities for the future
 - National survey of eye health and disease – linked to public awareness and access to services
 - How to identify the optic nerve at risk of pressure damage
 - Core outcomes and better measures of function
 - Key treatment trials: which treatments work best for which people especially those at greatest risk
 - Electronic patient records – user friendly and out of which data can be easily extracted – for AI and Deep Mind/Learning
 - Glaucoma registers and CVI data
- Filling the gaps
 - Treatment of newly diagnosed open angle glaucoma and ocular hypertension needing treatment
 - SLT vs. PGA = LiGHT – DONE – but any more trials in the pipeline?
 - Treatment of newly diagnosed advanced glaucoma
 - Surgery vs. standard treatment = TAGS – Nearly DONE
 - Relative effectiveness of existing medications in terms of preserving visual field
 - Timolol vs. brimonidine = LoGTS – inconclusive and needs doing again but different comparison?
 - New drugs and combinations but with the right outcomes
 - Minimally invasive glaucoma surgery devices – proper comparative effectiveness research (CER) – but what are the comparators?

DEBATE I: TRUSTY TRABECULECTOMY OR THE NEW KID ON THE BLOCK

Trabeculectomy for me any day

Prof Dale Heuer, retired professor and chair of ophthalmology and visual sciences, Medical College of Wisconsin, Milwaukee, WI, USA

- Extensive literature, including long-term outcomes, supports tried-and-tested trabeculectomy
- Preferred/consensus approach honed over decades of experience
 - Fornix-based conjunctival flap
 - Broad mitomycin C (MMC) application (by injection preferred)
 - Relatively tight scleral flap closure
 - Water-tight conjunctival closure
- New kids on the block are less invasive, less-artisanal procedures and the initial postoperative course is more predictable; question whether early postoperative management and follow-up is less intensive (less 'chair time')
- The cons for new kids are intraoperative conjunctival perforation, high needling rate and postoperative conjunctival erosion *Arnauld et al J Glaucoma. 2019; Arnijots & Economou Int J Ophthalmol. 2019*, use conjunctiva superiorly, techniques still evolving and limited short-/intermediate-term literature, no randomised studies vs. trabeculectomy
- In a study comparing gel microstent vs. trabeculectomy (for white ethnicity, highly significantly favoured trabeculectomy P=0.039) – study authors concluded there was no detectable difference in risk of failure and safety profiles between standalone ab interno microstent with MMC and trabeculectomy with MMC *Schlenker et al Ophthalmology. 2017*

Microshunts for me

Leon Au, Manchester Royal Eye Hospital, UK

- Glaucoma surgery preferences when the surgeon adopts the role of the patient show 14.1% opted for trabeculectomy (traditional, augmented with MMC) compared with 20.3% (trabeculectomy ab interno), 18.6% (XEN gel stent) and 14.3% (iStent, two devices) *Chang et al Eye Lond. 2019*
- Modern glaucoma surgery requires: less drops, earlier intervention to prevent damage; lower complication rates; shorter surgical time; easier surgery, less skill dependent; universal results; and better faster postoperative recovery
- Battle et al reported Preserflo microstent (formerly Innfocus MicroShunt) with MMC achieved IOP control in the low teens in most subjects up to 3 years of follow up *Battle et al J Glaucoma. 2016*, average IOP of 10.7 ± 3.5 mmHg and a decrease of 55% from preoperative IOP
- A study of observed cases using the Preserflo microstent showed mean ± SD IOP was reduced from 21.8 ± 3.4 mmHg at baseline (medicated) to 14.2 ± 3.2 at year 2 (33.8% reduction, n=59); 68.8% success rate at year 2
- Results: glaucoma medications – mean ± SD of glaucoma medications was reduced from 2.0 ± 1.3 at baseline to 0.5 ± 0.9 at year 2; of patients who did not have any glaucoma reoperations by year 2, 73.8% were medication free
- Microshunt postoperative regime: no weekly visit to clinic, no bleb manipulation, lower risk of hypotony/leak, little postoperative restriction, generally have minimal discomfort, combines quite well with phaco
- Good results reported in uveitis cases: XEN45 implant is an effective and safe treatment option for patients with medically uncontrolled glaucoma in the setting of uveitis, including those where urgent surgical intervention is required (IOP reduced from 36.1 mmHg preop to 12.6 mmHg at 12 months and last visit) *Qureshi et al J Glaucoma. 2019*
- Trabeculectomy is good (in good hands), but it is an invasive procedure, time consuming, difficult skill to master, delayed recovery and potential for complication

DEBATE II: ORAL SUPPLEMENTS FOR GLAUCOMA

■ Gimme all you got, I ain't taking no chances

Prof Jonathan Crowston, Duke-NUS Medical School, Singapore National Eye Centre, Singapore Eye Research Institute

- Proposed that it is unreasonable to deny the use of supplements to certain POAG patients where conventional therapies are not sufficient
- Nutritional supplementation in the treatment of glaucoma: a systematic review including 33 intervention studies, including 21 randomised controlled trials, concluded that the evidence is not conclusive, despite the strong theoretical rationale and initial clinical evidence for the beneficial effect of dietary supplementation as an adjunct therapy for glaucoma *Loskutova et al Surv Ophthalmol. 2019* – poor levels of evidence do not justify mass treatment of glaucoma patients
- Lack of robust evidence does not mean something is not effective
- Key points
 - We do not know whether supplements do or do not alter the natural history of glaucoma
 - Conducting clinical studies that provide the necessary evidence provide a major challenge and are probably unfundable
 - Treating physicians should be able to guide patients to supplements with the best safety profiles and stronger biological plausibility
 - Supplements may not improve visual outcome in glaucoma but may offer hope and empower patients

■ I want the finest evidence available evidence, here and now

Prof Gianni Virgili, University of Florence, Italy

- Refinement of clinical trial design and use of validated monitoring techniques may improve the cost burden and efficiency of clinical neuroprotective trials in glaucoma research' *Guymet et al Clin Exp Ophthalmol. 2019*
- We need translational research on oral supplements for glaucoma
 - Nutrients are not patent-protected, thus for-profit RCTs would not be cost-effective for any industry sponsor
 - Need publicly-sponsored trials
- Citicoline is a naturally occurring compound and FDA approved dietary supplement, recently demonstrated to be effective in ameliorating ischaemic stroke, traumatic brain injury, Parkinson's disease, Alzheimer's disease, cerebrovascular diseases, memory disorders and attention-deficit/hyperactivity disorder in both humans and animal models
- Ongoing RCTs
 - Citicoline eye-drops (evaluating efficacy in reducing progression of glaucoma)
 - Study of oral citicoline, effect of neurotidine® intake on QoL in patients with glaucoma
 - Evaluation of the antioxidant and neuroprotective effects of oral coenzyme Q10 (CoQ10) miniactives® in POAG patients
- Rare side effects noted
 - Citicoline: adverse reactions may include GI disturbances, transient headaches, hypotension, tachycardia, bradycardia and restlessness, and may exacerbate adrenocorticotrophic hormone- or cortisol hypersecretion-related disorders, including type 2 diabetes and major depressive disorder
 - CoQ10 generally well tolerated, however some people who are sensitive to the compound may experience side effects, such as diarrhoea, headache, nausea and skin rashes; do not take coenzyme Q10 without medical advice if using any of the following: omega-3 fatty acids, vitamins, blood pressure medicine, cancer medicine or warfarin

SESSION 1: COOL SCIENCE

Have we finally moved on from memantine?

Prof Jonathan Crowston, National University of Singapore, Singapore

- Learnings from memantine, for future neuroprotection studies:
 - Treat patients earlier in the disease process
 - Select patient with more refined progression criteria
 - Consider alternative tests/outcomes that show change over a shorter time period
 - These short-term changes should predict longer-term progression with classical endpoints
- A recently completed prospective study of nicotinamide (NAM, amide of vitamin B3) in glaucoma assessed change in retinal ganglion cell (RGC) function after 3 months of NAM supplementation
 - Photopic negative response (PhNR) improves after 12 weeks of NAM
 - Improvement in visual field (VF) MD with NAM – greater proportion had ≥ 1 dB improvement in VF MD on NAM vs. placebo, no change in PSD ($P=0.61$), improvement in VF not dependent on study visit
 - Safety and tolerability: treatment adherence rate $>94\%$ across the cohort, high-dose NAM (3.0 g/day) was very well tolerated
- Where to from here?
 - High-dose NAM can improve retinal function in a proportion (25%) of IOP-treated glaucoma patients
 - Larger study is being planned to determine whether short-term PhNR improvement predicts delayed progression with NAM
 - Currently, analysis investigating short-term structural changes (OCT and hyperspectral imaging)

The nicotinamide story

Prof Pete Williams, Assistant Professor, Karolinska Institute, Research Group Leader – Glaucoma, St Eriks Ogonsjukhus

- 'NAM treatment is profoundly neuroprotective in animal models; NAM supplementation prevents optic nerve degeneration in glaucoma'
- NAM treatment is robustly protective in glaucoma and clinical trials for NAM in glaucoma are underway. This highlights the importance of fully assessing NAM's effect(s) on RGCs
- Targeting NAD (an important metabolite for energy production and cellular homeostasis) in human glaucoma
 - Retinal NAD declines during age and following periods of elevated IOP in animal models
 - Retinal ganglion cells are highly sensitive to changes in NAD levels
- Sera nicotinamide is low in human POAG patients *Nzoughet et al IOVS. 2019*
 - Dietary niacin is low in Korean NTG patients
- Nicotinamide protects against decreases in basal oxygen consumption rate in fibroblasts from NTG patients *Garway-Heath et al ARVO 2018*
- Preventing NAD decline (genetically or pharmacologically) is robustly protective in multiple models of glaucoma
- Nicotinamide has amazing potential as a cost effective, potent neuroprotective for glaucoma with limited side effects
 - Nicotinamide may be even more efficacious in combination with IOP-lowering strategies

Growing and fixing meshwork

Dr Kate Keller, Casey Eye Institute, Portland, OR, USA

- In humans, 80% of aqueous humor exits the chamber via the TM
- Presentation reviewed TM cell culture and anterior segment organ culture, extracellular matrix modelling, targeting specific TM regions, TM cellular replacement and actin cytoskeleton
- Growing TM cells *Keller et al Exp Eye Res. 2018*
- Cultured TM cells are a valuable model system to study the cellular mechanisms involved in the regulation of conventional outflow resistance and thus IOP; and their dysfunction resulting in ocular hypertension *Keller et al Exp Eye Res. 2018*
- Stem cell replacement of TM cells
 - Findings by Zhu et al (Proc Natl Acad Sci U S A. 2016) suggest that lasting restoration of IOP control through induced pluripotent stem cells (iPSC)-TM transplantation is possible and may represent a novel treatment approach for glaucoma
 - Future needs: iPSCs have potentially less side effects than MSCs (mesenchymal stem cells); need to be able to home cells and get them to reside in TM
- Significance of tunnelling nanotubes (TNTs) in the eye
 - Provide a direct mechanism of cellular communication
 - Signals are not diluted in aqueous humor
 - Signals/cargoes can be transferred over long distances
 - Potentially be used to deliver payloads of drugs, virus, etc

The relationship between ambient atmospheric fine particulate matter (PM2.5) and glaucoma in a large community cohort

Prof Paul Foster, on behalf of The UK Biobank Eye and Vision Consortium

- Findings examining the effect of ambient air pollution on glaucoma in UK Biobank participants *Chua et al IOVS. 2019*
 - Effect of PM2.5 exposure on IOP was negligible, although PM2.5 exposure increased the odds of self-reported glaucoma by 6%
 - Significant association between higher current PM2.5 exposure and both a higher risk of self-reported glaucoma and thinner macular ganglion cell-inner plexiform layer (GC-IPL)
 - The association appears independent of IOP
 - Effect of PM2.5 exposure on glaucoma is possibly mediated by a neurotoxic or vascular mechanism
- Further research warranted into the effects of fine particulate air pollution on both RGC physiology and retinal vasculature

SESSION 2: UNDER THE KNIFE

New tubes for old?

Prof Dale Heuer, Eye Institute Milwaukee, USA

- Aqueous shunt (future) challenges
- Achieving sufficiently low IOP (LIMBO, lower IOPs make better outcomes) *Jung et al Sci Rep. 2019*, quickly and predictably, without supplemental ocular hypotensive medications, prevent vision loss and minimising complications
- Tube Versus Trabeculectomy (TVT) study five-year conclusions *Gedde et al Am J Ophthalmol. 2012*
 - Aqueous shunts were more likely than trabeculectomy with MMC to maintain IOP control, but among aqueous shunt patients, almost one out of three (30% vs. 47%) had IOP >21 mmHg* and about one out of three (32% vs. 54%) had IOP >17 mmHg* (*or not reduced by 20% below baseline on two consecutive follow-up visits after 3 months, IOP < 5 mmHg on two consecutive FU visits after 3 months, reoperation for glaucoma, or loss of light perception vision)
 - At five years, both procedures had similar IOP reductions and use of supplemental medical therapy but only 25% (tube) vs. 29% (trabeculectomy) were 'complete successes', there was no difference in rates of vision loss between the two procedures (but about one in three patients lost ≥2 Snellen lines of VA and about four in every five phakic patients had progressive cataract)
 - Rates of late postoperative complications and serious complications associated with vision loss and/or reoperation were similar for both procedures, but those occurred in about one in five patients (22% vs. 20%)

Which operation for which patient? Or Who gets what, when?

Gus Gazzard, Professor of Ophthalmology, UCL and Director, Glaucoma Service MEH

- There is no zero risk IOP-control: there is a hierarchy of need and a hierarchy of risk, and it is question of balancing both
- New devices, old tubes, new tools and techniques vie for our attention, leaving clinicians with a myriad of choices, but many choices have no evidence from RCTs and never will do (some suggest MIGS as a primary procedure for OAG)
- Which operation for which patient? A procedure of only modest benefit might be worth the minimal additional risk, especially as modest reductions are all that many require, while a greater benefit might be worth a greater risk, but only when targeted at the correct patient group
- Risk and benefit both change over time, while benefits, harms and probability are perceived differently by different patients and doctors (e.g., confirmation bias); benefits and harm are many, varied and not always predictable
- 'Sulcus-based tubes will be part of the future'
- For PACG, the first choice operation and always is early lens extraction

- So, which operation for which patients with POAG?
 - Phaco plus microstent implantation may be considered for POAG patients with cataract
 - For POAG patients where selective laser trabeculoplasty (SLT) + maximally tolerated medical therapy is insufficient, either trabeculectomy for sub-10 mmHg IOP target, or microshunt implantation may be an option for high myope or uveitic patients
 - For failed needled trabeculectomy, tube shunt procedure with Baerveldt (BVT) glaucoma implant
- Trabeculectomy with MMC achieved lower IOP with use of fewer glaucoma medications compared with tube shunt surgery after 3 years of follow-up in the Primary Tube Versus Trabeculectomy (PTVT) Study *Gedde et al Ophthalmology. 2019*. • Regarding use of gonioscopy assisted transluminal trabeculectomy (GATT), Kahook, ABiC, iStents + endocyclophotocoagulation (ECP) and other options: 'perhaps, but only as part of carefully monitored research, with full and frank consent about lack of evidence, and ethics approval for experimental procedures'
- Remember the Grandmother Rule: 'finally, let's always ask ourselves, what would we want if our grandmother had this?'

Trickle or squirt? Getting the right flow

Leon Au, Manchester Royal Eye Hospital, UK

- One-year results of XEN45 implant for glaucoma in a retrospective case series reported 77% were off drops at 6 months and 59% at 12 months; the mean preoperative IOP was 24.9 ± 7.8 mm Hg on three drops, which reduced to 14.5 ± 3.4 mm Hg at month 12 ($P < 0.005$) on 0.7 drops ($P < 0.005$) *Tan et al Eye (Lond). 2018*
- Ahmed vs. BVT: the Ahmed tube features an inconsistent valve, bulky bleb, hypertensive phase, and less efficacious; the BVT outperforms Ahmed for IOP control but provides no flow control
- Molteno 3 has limited effectiveness based on case experience
- Discussed comparisons between the eyeWatch system (Rheon® Medical), an adjustable 'fully titratable' glaucoma drainage device (GDD), and BVT tube: the BVT shunt requires an extra intervention to remove the occlusive element, while no re-intervention is required with the eyeWatch system
- Clinical data from Manchester using the eyeWatch through 180 days ($n=12$) and 360 days ($n=4$) demonstrate effective IOP lowering 'down to BVT levels', with reductions in number of augmented medications
- Successful retro eyeWatch rescue of refractory hypotony after BVT drainage device implantation has been reported (Elahi et al J Glaucoma. 2020), while conjunctival compression sutures are an effective option for addressing persistent hypotony following XEN45 implant insertion in patients with uveitic glaucoma *Yu & Au Eur J Ophthalmol. 2020*

The ethics of glaucoma widgets

Prof Tanuj Dada, All India Institute of Medical Sciences, India

- Gold standard glaucoma surgery is trabeculectomy with MMC: a high yield, high risk and high maintenance surgery
- Discussed innovations in glaucoma surgery to make it more effective, safer and economical *Dada et al Indian J Ophthalmol. 2017*, for example augmented trabeculectomy with creation of an intrascleral lake

- Should clinicians use Ologen implants as a replacement or adjuvant to MMC?
 - A randomised comparative study found that the addition of a biodegradable collagen implant (Ologen) did not improve efficacy of MMC-augmented trabeculectomy in primary adult glaucomas *Sen et al Ophthalmology Glaucoma. 2018*
 - Patch graft using collagen matrix (Ologen) for glaucoma drainage device exposure may be useful *Rosentreter et al BMC Ophthalmol. 2018*
- Primary surgery: should a tube replace a trab?
 - At 1 year follow-up in the PTVT study, trabeculectomy (MMC 0.4 mg 2 min) had higher success, less need for medications and lower IOP compared with tube shunt implantation *Gedde et al Ophthalmology. 2018*
 - Sight-threatening adverse outcomes in GDD implantation were three times higher than trabeculectomy surgery *Stein et al Ophthalmology. 2008*
 - Trabeculectomy is cost-effective at a substantially lower cost per QALY compared with tube insertion *Kaplan et al JAMA Ophthalmol. 2015*
 - 'Say "NO" to primary tubes, and never do a tube as primary surgery in a phakic patient'
- Are new and novel glaucoma devices minimally invasive (i.e., MIGS) or minimally effective (i.e., MEGS)?
 - Sheheitli and colleagues argued that MIGS procedures are not likely to be effective if the surgical goal is a marked reduction in IOP or control of a very high IOP *Sheheitli et al Asia Pac J Ophthalmol (Phila). 2019*
- MIGS: ethical issues
 - Disparity between existing quality of evidence on effectiveness of MIGS and adoption by clinicians
 - Its usage is primarily governed by surgeon preference, training, experience and comfort
- Primary surgery: should a XEN® implant replace a trabeculectomy?
 - Ab interno approach has greater outflow resistance and less predictable bleb formation than ab externo approach *Lee et al Transi Vis Sci Technol. 2019*
 - Schlenker et al reported no detectable difference in risk of failure and safety profiles between standalone ab interno microstent with MMC and trabeculectomy with MMC; 43% and 31% underwent needling, respectively, and 50% of trabeculectomy eyes underwent laser suture lysis, with a <45% IOP reduction at 12 months with XEN45 *Schlenker et al Ophthalmology. 2017*
 - XEN® stent complications reported from a case series report include exposure, migration, fragmentation, dislocation, bleeding, needling and long-term risk of blebitis *Gupta & Mathews BMC Ophthalmol. 2019*
- Ex-Press glaucoma filtering device (>100,000 implants done) was associated with an increased rate of corneal endothelial cell loss compared with trabeculectomy through 2 years of follow-up *Arimura et al Sci Rep. 2018*
- The current published evidence suggests MIGS (Ex-Press®, XEN®, Preserflo®) is similar to trabeculectomy in terms of success, IOP, number of glaucoma medications, and complications but at a higher surgical cost

SESSION 3: WHEN KIDS GROW UP: PAEDIATRIC OPHTHALMOLOGY IN GLAUCOMA

Issues related to childhood-onset glaucoma in adults

John Brookes, Moorfields Eye hospital, London, UK

- Reviewed challenges of treating adults with childhood-onset glaucoma, noting that such cases were more challenging, with higher failure and complication rates than adult-onset glaucoma
- Stressed that paediatric glaucoma is a surgical disease
- Reviewed results evaluating 3600 trabeculectomy vs. goniotomy in congenital glaucoma
 - At MEH, transition from goniotomy to 360o trabeculectomy, presented 1 year results in 106 eyes (54 MCT, 52 gonio): 94.3% qualified success (MCT) vs. 34.6% (Gonio), further surgery 7.4% vs. 63%, respectively. At final follow up, 85% qualified success (MCT) vs. 37% (Gonio), reflecting "very good results" with MCT through long-term follow-up
- Conclusion
 - Children with glaucoma become adults with glaucoma
 - Often require more aggressive management due to long term nature of the disease and more advanced disc damage
 - Long term complications (of surgery in childhood glaucoma) will become more evident
 - Further surgery more complex, due to anatomical aspects of the eye and multiple previous operations
- Key message: Successful treatment of adults with childhood-onset glaucoma depends on their successful treatment in childhood

Angle surgery in children

Prof Allen Beck, Redmond Professor and Chair, Emory University Department of Ophthalmology, Atlanta, GA, USA

- Circumferential angle surgery approaches are likely being used more commonly in paediatric glaucoma with very good to excellent outcomes (visual outcomes can be astonishing) (Neustein & Beck Am J Ophthalmol. 2017)
- Technological advances are enhancing the ability of surgeons to perform circumferential angle surgery
- Angle surgery of all types remains the treatment of choice for primary congenital glaucoma, with broader applications for other childhood and adult glaucomas
- Conventional trabeculectomy procedure combined with trabeculectomy (± adjunctive MMC) offer potential for dual outflow: several studies have documented enhanced success of this procedure compared with goniotomy or trabeculectomy in countries where late presentation and familial cases are common
- Future directions
 - GATT, Trab 360 device and Kahook Dual Blade (New World Medical) all require good visualisation of angle anatomy so are limited by goniotomy/ab interno approach
 - Buphthalmic infant anterior chambers are less forgiving than adults given the greater tendency to shallow or flatten
 - GATT and Trab 360 do allow the potential for circumferential angle surgery as in ab externo suture and illuminated microcatheter trabeculectomy

■ Paediatric trabeculectomies and tubes

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- Childhood glaucoma is characterised by IOP-related damage to the eye, which can be caused by a very diverse group of paediatric conditions; the aim of management, where possible, is to provide a lifetime of vision
- Surgery is the mainstay of treatment; however, the surgical management of childhood glaucoma is challenging, largely because of its greater potential for failure and complications as compared with surgery in adults
- Three complications of tube shunt surgery are consistently reported as being more common in the paediatric versus the adult population: tube malposition (corneal touch), tube migration into or out of the eye (32% requiring surgery) and tube erosion and endophthalmitis (up to 10%, both Ahmed and BVT)
- Simple modifications to the trabeculectomy technique have been shown to considerably minimise complications
 - For contemporary paediatric trabeculectomy technique augmented with MMC undertaken within the first 2 years of life, cumulative probabilities of success after surgery were 78% at 1 year, 67% at 5 years and 60% at 7 years – these results compare favourably to previous drainage shunt surgery studies *Jayaram et al Ophthalmology. 2015*
- Modern trabeculectomy can be an effective as well as safe procedure in infants, likely to be off drops afterwards and avoids the complications of tubes
- However, GDDs maintain a vital role for certain types of glaucoma including those refractory to other surgery – Beck et al reported probability of success of 53% for tubes vs. 19% for trabeculectomy with MMC at 6 years' follow-up for children treated in the first two years of life *Beck et al Am J Ophthalmol. 2003*
- In the future, we need
 - 1) high-quality prospective surgical trials and
 - 2) a standardised definition of success, which is lacking in childhood glaucoma

All sessions from the Moorfields International Glaucoma Symposium 2020 that are summarised in this booklet were also videoed in full. These videos can be found at www.migs.org.uk/gallery/2020/.

