(persistent or increased intra- and subretinal fluid, retinal thickness), FAG findings (active leakage, lesion growth) and ophthalmoscopic symptoms, such as a new haemorrhage. The choice of these parameters seems logical, as they hint at a continuing active neovascular process. If previous treatments have been shown to improve or at least stabilise the eye condition, further treatments would be justified.

National and international retina societies are intensively working on guidelines for anti-VEGF therapy. Recommendations from the view of the retina specialists might differ from indications that insurances will be ready to cover due to of the economic pressure on healthcare systems. Furthermore, studies on vision-specific quality of life indicate that ARMD that affects either the first or the other eye has a different impact on quality of life. Future guidelines could include the patient's binocular condition as well.

At present, ranibizumab and bevacizumab are the most powerful weapons

against neovascular ARMD and definitely more efficacious than PDT and pegaptanib. Meanwhile, ranibizumab is available in many countries, but retina specialists continue to use intravitreal bevacizumab as a low-cost alternative for treatment of neovascular maculopathy. Alternative treatment regimes are under investigation to reduce the total number of injections and to individualise therapy based on the need for follow-up injections (PIER, PrONTO) as well as studies on combination therapies (PROTECT, SAILOR). All these investigations are aimed at improving the efficacy of therapy, minimising the number of follow-up injections, decreasing the cumulative risk of injection-related endophthalmitis and reducing the enormous economic burden of a (possibly lifelong) therapy.

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Corneal transplant surgery

"Small bubble technique" helps "big bubble technique"

Francis W Price Jr

Surgeons will increasingly use big bubble technique

Corneal transplant surgery has recently seen rapid and exciting changes on multiple fronts, following several previous decades of only minimal change after introduction of the operating microscope and monofilament sutures. New transplantation techniques are primarily taking off on three fronts: endothelial keratoplasty (EK), femtosecond laser assisted penetrating keratoplasty (PK), and anterior lamellar keratoplasty (ALK). All three of these procedures address one of the primary limitations of traditional PK—that is, poor wound healing.

The increasing use of EK to treat dysfunctional corneal endothelium is a prime example of how rapidly a new technique may be adopted once it evolves to the point that it produces superior outcomes and can be reliably performed. For example, the first EK technique not requiring corneal sutures to hold the graft in place was introduced about nine years ago.¹ Subsequent improvements, including methods to reduce the incision length

and amount of tissue removed from the recipient eye, resulted in the iteration known as Descemet's stripping with endothelial keratoplasty (DSEK), introduced in late 2003.^{2–4} At that time the number of EK procedures was so low that they were not even tracked by the Eye Bank Association of America (EBAA). By the time the EBAA began tracking use of EK procedures in 2005, they represented 4.5% of the grafts performed in the United States. By 2006, EK procedures represented 18% of US grafts (2006 Eye Banking Statistical Report, Eye Bank Association of America), and based on current levels of demand for donor tissue, the number of EK procedures is expected to further double in 2007.

Femtosecond laser contoured PK is still quite young—the first procedure was performed at our centre in late 2005. Early results suggest that interlocking incisions created with a femtosecond laser may result in faster wound healing with less induced astigmatism than standard PK. As the hardware and software to

perform this procedure are introduced at more centres around the world, we expect the number of procedures performed this way to dramatically increase.

ALK has been performed for many years using various methods. Most have involved the use of metal blades to perform hand dissections of varying depth on both the donor and recipient corneas. The major problem with these techniques has been difficulties with visual recovery because of irregularities in the dissection planes. Manual dissections by necessity introduce some irregularities, so the donor and recipient interfaces seldom match up perfectly.

An elegant method of using a small secondary bubble in the anterior chamber to help determine if a successful big bubble has been achieved

Microkeratomes have been used to help create smoother dissection planes, but even with a microkeratome it can be difficult to precisely match the dissection depths in the donor and recipient corneas. Limitations with hand and microkeratome dissection techniques have led surgeons to develop methods for removing all, or most, of the corneal stroma in the recipient with transplantation of all but the donor endothelium and Descemet's membrane, a technique known as deep anterior lamellar keratoplasty (DALK). Melles *et al* introduced a method of filling the anterior chamber with air to help the surgeon more

accurately estimate the dissection depth and this method can facilitate hand dissection down to deep stromal tissues just above Descemet's membrane in the recipient cornea.² This technique can be especially helpful in cases of deep stromal scarring involving Descemet's membrane. With deep bladed dissections, however, there is always the risk of perforating the Descemet's membrane into the anterior chamber. Anwar's big bubble technique has provided a dramatic advance in corneal transplant surgery by helping to avoid or minimising the risk of perforation with DALK.³

First published in 2002, Anwar's big bubble technique provides essentially a full thickness graft while retaining the patient's own endothelium.³ This helps minimise or eliminate the risk of immunological endothelial rejection, although stromal rejection episodes can still occur. Stromal interface irregularities are also eliminated because an extremely smooth stromal surface, which is exposed by removing Descemet's membrane from the donor graft, is laid directly onto the recipient's bare Descemet's membrane. The big bubble technique can lead to 20/20 best corrected visual acuity (BCVA) and rivals visual acuity results obtained with full thickness penetrating keratoplasty (PK). However, visual recovery may still be limited if folds or wrinkles occur in the recipient Descemet's membrane within the visual axis or pupillary area.

While use of the big bubble technique is increasing, its rate of adoption has been slower than that of DSEK or femtosecond laser PK. Why is that? One obvious explanation is the lack of a "corporate sponsor" who can directly benefit from adoption of this new technique. For

example, Moria developed instruments for DSEK and sold both artificial anterior chambers and microkeratomes to facilitate the procedure. Moria has widely publicised DSEK, calling it DSAEK (Descemet's stripping automated endothelial keratoplasty) when its microkeratome is used to prepare the donor graft. Moria has also hosted symposiums and promoted independent courses that have increased awareness of DSAEK and helped surgeons learn the technique, which is generally considered more difficult than standard PK. The big bubble technique does not have a corporate sponsor.

A second hurdle it must overcome in order to achieve widespread adoption is reproducibility—either real or perceived. The adoption of EK was slow until DSEK was shown to be reproducible and predictable. With "big bubble" procedures, there are concerns about bubble rupture and the need to convert to a PK. While that outcome is not the end of the world, because PK is the alternative procedure anyway, it does represent a letdown to both the patient and the doctor. More importantly, conversion to a PK dramatically changes the quality of the donor endothelium required for the case. In "big bubble" procedures, the donor tissue can have little, or no, viable endothelium because the endothelium is not transplanted. By comparison, in PK a good endothelium is necessary for graft viability.

In this issue of the *BJO*, Parathasarathy *et al*⁶ report an elegant method of using a small secondary bubble in the anterior chamber to help determine if a successful big bubble has been achieved to help separate Descemet's membrane from the central cornea of the recipient (*see pages*

1369–73). The small bubble can help the surgeon assess the extent of the big bubble in cases where the cornea is opaque, either from previous pathology, or when air diffusion into the peripheral cornea prevents direct visualisation into the anterior chamber. This addition to the big bubble technique should enable it to be used more reliably.

As the big bubble technique continues to improve, we expect that surgeons will increasingly utilise it because it not only provides benefits for patients, but also allows utilisation of corneal donor tissue unsuitable for standard PK. In the face of increasing demand for corneal donor tissue, these advances are certainly welcome.

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Spectral transmission of IOLs expressed as a virtual age

Spectral transmission of IOLs expressed as a virtual age

David H Sliney

The concept of the "virtual age" forms a useful means of comparison of different IOLs with regard to short-wavelength spectral properties

In this issue, van Norren and van de Kraats¹ propose a novel means for comparisons of different IOLs with

regard to short-wavelength spectral properties. (*see pages* 1374–5) They have developed the concept of defining an

equivalent age for comparing the spectral properties of any IOL with those properties of the ageing natural crystalline lens, which they term a "virtual age." Recognising the need to balance short-wavelength protection with visual performance in the blue-violet, they have defined two "virtual ages," one for "photoprotection" and one for "photo-reception." Of course, the reference age is based upon properties of northern European lenses, but the concept allows the ophthalmologist and patient an understandable means for comparison.

Arguments will remain as to the best spectral transmission curve—the best choice of spectral age—but the concept allows for a quick comparison in terms of degree of protection against some types of