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Sir,

Endoscopic visualization to aid deep anterior lamellar keratoplasty

We welcome the interesting work by Drs Moore *et al* [1]and want to applaud the authors for their novel ideas. However, we must take exception to the statement that 'an adequate air bubble is not commonly seen'. Both Dr Anwar and myself are able to produce the 'big bubble' consistently: in 40–60% of eyes on the first try, in 80–90% of eyes on the aggregate of the first two tries, and in nearly all eyes when various additional manoeuvers (such as additional air injections, or preliminary anterior keratectomy followed by fluid injection and further air injection) are used in the initially resistant cases.

We maintain that the 'Big Bubble' technique[2,3] is the most efficient way of performing maximum depth lamellar keratoplasty—an essential feature of which is the baring of the host's Descemet's membrane over the central region of the cornea. Two prerequisites for successful use of the 'Big Bubble' technique are

(a) that a 'big bubble' has actually been generated, and
(b) that the surgeon is aware of this fact.

Success of (a) depends on close observation of several details, several of which were ignored in this experimental work:

(1) In their paper, Dr. Moore and coauthors do not mention that they trephined the cornea prior to injecting the air. This important first step of the 'Big Bubble' technique serves to 'isolate' the central cornea (to a large extent) from the peripheral cornea. Failure to perform this step may aid excessive spread of air into the corneal periphery, to the trabecular meshwork and into the anterior chamber instead of deep spread towards Descemet's membrane.
(2) The authors made an opening into the eye (to insert the endoscope) *before* injecting the air. Again, this would facilitate air entry into the anterior chamber. Air inside the anterior chamber directly competes for space with the 'big bubble'. The more air that is present in the anterior chamber (and the higher the pressure), the smaller will be the room available for the bubble of Descemet's detachment.
(3) A 26 gauge needle was used for injecting air into the cornea instead of a 27 or 30 gauge needle. (At this time, the relevance of this difference in technique is uncertain.)
(4) The force of the initial air injection may not have been sufficient.
(5) As the authors of the paper conceded, it is possible that cadaver eyes react different from live eyes. Further, it is conceivable that the pathological conditions for which this surgery is performed actually predispose these eyes to the formation of a central detachment of Descemet's membrane.
(6) Finally, we want to stress that here too, as in other skills, a certain learning curve is natural.
(7) Despite the differences in technique listed above, the authors did record the formation of several small bubbles of air between Descemet's membrane and deep stroma. Hence, it seems that some areas of detachment were generated, albeit not a confluent central region.

Regarding point (b) above, we diagnose a 'big bubble' by several characteristic features: the first indication is that the air (the blanching of the corneal stroma) spreads in a wave-like manner—like waves spreading over water when a drop falls on a calm surface—*in a circular fashion*. A completed bubble frequently exhibits a feathery white band at its (circular) periphery—offset, by a band of darker cornea, from the whitened region of air-insufflated stroma near the needle tip. (In some very rare cases, a 'big bubble' can be achieved without any air infiltrating/whitening the corneal stroma.) The anterior

surface of the cornea 'rises,' that is, moves anteriorly as the bubble takes up some space in the central cornea. This bulging is accentuated after the performance of an anterior keratectomy.

The endoscope may certainly be able to contribute proof. This would be particularly important if the surgeon is not yet experienced with this procedure. As point (2) above indicates, however, the endoscope should only be used as a last step, that is, to confirm the presence of a big bubble. As use of an endoscope very likely compromises the outcome of the air injection, it should not be carried out too early. It should never be employed to confirm the impression that a big bubble had not yet formed. (A final consideration is that the insertion of an endoscope could prove risky in phakic eyes unless the anterior chamber first be stabilised with viscoelastic substances.)

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Sir,

Reply to KD Teichmann and M Anwar

I would like to thank Drs Anwar and Teichman for their useful comments.

A 'big bubble' can be formed in nontrephined corneas and even with their own results there is a chance, although only 10–20% after the second air injection that a 'big bubble' does not form.[1] In our four cadaver eyes we did not see a 'big air bubble'[2] and perhaps with a larger series we would have achieved better results. However, the question remains what to do if a 'big air bubble' does not form. Endoscopic visualisation of the posterior surface of the cornea is a possible aid to confirm or refute the presence of a 'big air bubble', the ideal end point. This information may aid the surgeon on how to proceed. Reinjection into opaque cornea in a different site is difficult and may cause perforation and unnecessary if a 'big air bubble' had formed but not been recognised. Dissection without a 'big air bubble' is time consuming with a higher chance of 'irregular dissection' and less than optimum visual results.

It is the thin ectatic corneas that present a surgical challenge to any lamellar technique, and prior trephination in such eyes is hazardous. Drs Anwar's and Teichman's method states the importance of prior trephination to isolate the central cornea and may aid deeper spread of air towards Descemet's membrane, thus helping formation of the 'big air bubble'.

Excessive air injected into pretrephined eyes escapes from the trephined interface. Air entry into a closed eye would impede air dissection more posteriorly into the cornea as intraocular pressure is raised. However, one could argue that air entry through one of our paracentesis, which we were careful to avoid, would create a softer eye than fluid inside the anterior chamber and possibly aid a 'big air bubble formation'.

Again I would like to emphasise that our experiment was in cadaver eyes and this could explain the differnce between Drs Anwar's and Teichman's results and ours.

Direct endoscopic visualisation remains an alternative to aid visualisation and surgery affecting the posterior corneal surface particularly in situations where the view is compromised. It may also help future developing techniques such as Descemet's transplantation[3–5] as such tissue is difficult to visualize by its transparent nature and delicate to handle. Reorientation of Descemet's membrane[6] may also be aided by direct visualisation with an endoscope.

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