

CORNEA

Big-Bubble DALK: Is It Right for Your Practice?

BY ANNE SCHECK, CONTRIBUTING WRITER

INTERVIEWING MASSIMO BUSIN, MD, IRVING M. RABER, MD, AND DONALD T.H. TAN, MBBS

Growing evidence suggests that deep anterior lamellar keratoplasty (DALK) yields satisfactory visual outcomes and substantially increases graft survival in corneal transplantation. And for the past decade, observers have predicted that the big-bubble version of DALK—which has been credited with the highest degree of success—will supplant penetrating keratoplasty (PK) for diseases affecting the anterior cornea.

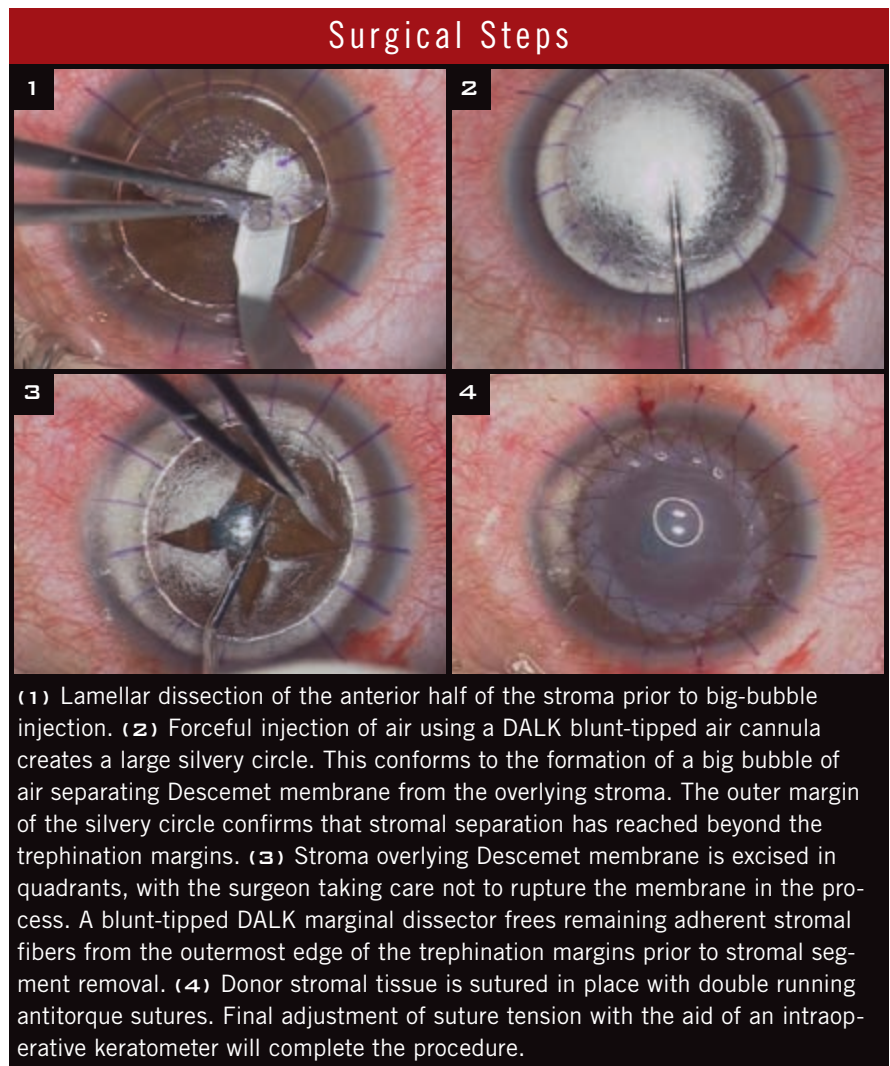
Yet PK is still the surgery of choice for U.S. patients with keratoconus, the most common corneal degenerative disease, as well as for many other dystrophies of the cornea. So what's behind the lag in the adoption of big-bubble DALK?

"DALK will generally take longer than PK to perform, even in the best of hands," said Donald T.H. Tan, MBBS. "But that is a reasonable trade-off when one considers that many post-operative PK complications can be avoided with DALK in the long term." Here are some factors involved in considering that trade-off.

How It Works

PK relies on a full-thickness graft in which a disc of donor cornea is placed into a recipient cornea, at a circular excision of the same size. In DALK, only the anterior layers of the patient's cornea are removed, allowing for a selective, partial-thickness replacement.

In big-bubble DALK, the cornea is trephined for 60 to 80 percent of its



thickness, relative to the thinnest point of the cornea in the area of trephination. Air is injected into the deep stroma, expanding in a plane and causing a separation of the Descemet membrane from the overlying stroma up to

0.5 to 1 mm away from the trephination edge.¹

Big-Bubble Benefits

Better graft health. Big-bubble DALK is a "game-changer," said Irving M.

Raber, MD. Creating the air-filled cavity usually—and effectively—separates the deep stroma from Descemet membrane, he said. As a result, the membrane is bared and spared, and the donor transplant can be applied on top of Descemet membrane and host endothelium. In most studies, risk of rejection is significantly lower than that seen with PK. Because the procedure is limited to the stroma, it presents much less of a threat to the long-term survival of the graft, Dr. Raber said.

This is critical in that the complications of graft rejection appear to be a common factor for surgical failure of PK, according to a 2011 registry study of more than 4,000 recipients of long-term corneal transplants in Australia, most of whom had keratoconus.²

Donor pool. Compared with posterior lamellar keratoplasty approaches, big-bubble DALK can draw from a larger pool of donors. In particular, both Descemet stripping automated endothelial keratoplasty (DSAEK) and Descemet membrane endothelial keratoplasty (DMEK) have narrower graft criteria. Thus, tissue with poor endothelium that can't be used for DSAEK or PK may be acceptable for DALK, said Massimo Busin, MD.

Standardization. There has been a wave of refinement in big-bubble DALK technique.³ Reported outcomes across studies show that complications are less common than even two or three years ago, probably because the procedure is becoming “a lot more standardized,” Dr. Busin said. Such benefits “argue persuasively” for considering a shift to big-bubble DALK, Dr. Raber said. “Keratoconus now means the big bubble for me.”

Conversion. If the surgeon cannot obtain a big bubble during the procedure, manual lamellar dissection can be attempted, or the big-bubble procedure can be easily converted to PK. “So what's to lose?” Dr. Raber asked.

Reasons for Caution

Wound healing time. With PK, sutures often require a wound-healing time of a year and a half or more. Some proponents of DALK state that the procedure

cuts this time in half. However, Dr. Raber cautioned, “I haven't seen any supportive data, and my experience is that when I tried to remove sutures earlier than I would in PK, I had a few cases of wound slippage. I usually use interrupted sutures and don't start selective suture removal until at least four to six months have passed.”

Refractive errors. “You do still have issues of astigmatism and refractive errors” with the big-bubble technique, Dr. Raber acknowledged—but no more so than with the manual DALK that preceded it or, for that matter, with PK, he said. “If the patient's vision after DALK doesn't seem quite as a successful as with PK, wait a while. I've seen it improve month by month.”

He added, “In my experience, vision following DALK—when successfully completed with the big-bubble technique—is identical to that achieved with PK. When manual dissection is done and some stroma is left, vision tends not to be as good as that seen with PK.”

Perforation. The problem of perforation while trying to obtain the bubble can be a substantial complication, Dr. Busin said. Unfortunately, the literature on this has failed to distinguish between microperforations and larger tears; thus, the extent of the impact of this occurrence hasn't been fully clarified, he noted. Some studies put incidence of perforations in as many as a third of the big-bubble surgeries, while others report it as nearly nonexistent. Postsurgically, Descemet membrane detachment may occur, even in patients with microperforations that initially seem inconsequential.

One of Dr. Raber's patients developed a detachment following uneventful big-bubble DALK, even though Dr. Raber was certain that no perforation had occurred. “The detachment spontaneously resolved, and the patient did well,” Dr. Raber said.

Choice of technique. A point of potential confusion has to do with pre-Descemet versus Descemet DALK. Pre-Descemet DALK has been shown to be associated with lower risk of membrane rupture. In

this variation, tissue is removed down to the pre-Descemet layer, a level that is characterized by translucency but is not so opaque as to prevent visibility of the pupil. However, the traditional big-bubble technique typically has the highest incidence of Descemet membrane exposure and eschews a pre-Descemet plane.

Compared with pre-Descemet DALK, Descemet DALK “clearly provides superior visual outcomes,” Dr. Tan said. However, it is more challenging because of the higher risk of perforation and the fact that it is not always possible to achieve big-bubble separation of Descemet membrane, he said.

The recent discovery of Dua's layer between the stroma and the Descemet membrane⁴ may help elucidate these technical questions.

Additional Considerations

Training needed. Big-bubble DALK is “a technically challenging procedure,” Dr. Tan said, despite the potential for fairly rapid conversion into a PK. It “takes skill and experience,” he said.

Given potential complications such as perforation, Dr. Busin recommends that interested ophthalmologists pursue advanced training to learn the procedure. “There is a need to see the problems that can occur and then see how they can be handled,” he said.

Potential modifications. As with any new procedure, the big-bubble technique continues to be refined. Dr. Tan cited modifications that he and other researchers have made, including manually dissecting an anterior area of the stroma to a depth of 50 to 60 percent before injecting the air, enabling deeper and more central placement of the needle; using a special blunt cannula in order to avoid perforation; and performing the “small-bubble test,” which allows the surgeon to confirm that true big-bubble separation of the Descemet layer has occurred.

The latter is particularly helpful for cases in which visualization is obstructed by overlying stromal air, Dr. Tan said. “If a convex big bubble is present, the small bubble introduced into the anterior chamber through a

peripheral paracentesis stays in the periphery and can be visualized.”

But this modification needs further study, Dr. Raber cautioned. “Injecting air after the big bubble has been obtained could potentially perforate the bubble from the inside.”

Acceptance Ahead?

One of the great advantages of DALK is that it does not create a large full-thickness trephine opening through which intraocular contents can prolapse in the presence of positive pressure, Dr. Raber said. As he noted, “This is one of the most dreaded intraoperative complications” faced by corneal transplant surgeons.

Despite this advantage, surgeons have lacked adequate justification for pushing aggressively for adoption of either manual or big-bubble DALK because there weren’t many side-by-side comparisons with PK. But that isn’t the case now, Dr. Raber said.

Visual acuity and topical steroids.

Dr. Raber cited a series by Dr. Tan and colleagues, who compared 32 eyes that underwent big-bubble DALK with the same number of eyes that had undergone manual-dissection DALK. The DALK patients were then compared with 64 eyes that had undergone PK. DALK yielded better visual outcomes, with big-bubble DALK showing superiority. In the follow-up of about 100 patients, the PK group used steroids for an average of two years. Patients in the two DALK groups used the drops, on average, for only six to eight months, with a significant reduction in steroid-related complications such as glaucoma and cataract.⁵

Inflammation and healing. One review of big-bubble DALK outlines its advantages over other keratoplasty procedures. In particular, the review states that the procedure offers the likelihood of a better visual outcome because there is little or no change to the intraocular anatomy; there is reduced inflammation compared with PK; and there is increased strength and stability of wound healing.⁶

Technical advances. The U.S. Food and Drug Administration has

cleared handheld optical coherence tomography, which may allow better visualization of the cornea during surgery. In addition, femtosecond lasers are now being used to create a channel for the air-injecting cannula before a big-bubble attempt is made, to reduce the risk of perforation by providing an “intra-bubble” first.⁷ The femtosecond laser also is expected to increase the rate of success in obtaining the big bubble “by virtue of guaranteeing the depth of the air injection,” Dr. Raber commented.

Despite these advances, there is no more remuneration by insurers for the added time involved in DALK versus PK, Dr. Raber said. “Old habits die hard. To date, most insurance carriers reimburse less for DALK than they do for PK.” ■

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7 Buzzonetti L et al. *J Ophthalmol*. 2012; 2012(264590). doi:10.1155/2012/264590.

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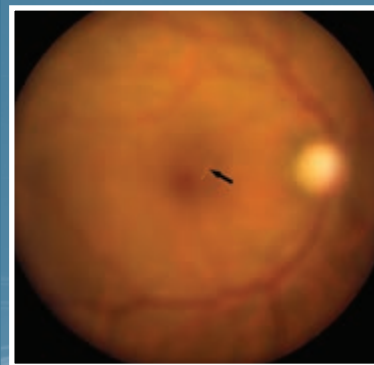
Dr. Tan is director of the Singapore National Eye Center. Financial disclosure: Receives grant support from AcuFocus and Carl Zeiss Meditec; lecture fees from Alcon, Bausch + Lomb, and Santen; and royalties from Network Medical Products.



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