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Determination of the size of the stripping area using trypan blue in Descemet’s stripping only

In recent years, corneal endothelial transplantation has become a standard procedure in the surgical management of Fuchs endothelial corneal dystrophy (FECD). Despite the recent development of effective surgical techniques, corneal endothelial transplantation is still associated with many complications, including transplant rejection, graft dysfunction, postoperative complications, and the scarcity of donor grafts.

In contrast to corneal endothelial transplantation, Descemet’s stripping only (DSO) is a less invasive procedure that involves the descemetorhexis zone without transplantation of the donor graft. Moreover, implementing DSO may reduce the shortage of donor grafts. Hence DSO has gained attention as a potential alternative to corneal endothelial transplantation in patients with FECD. However, the efficacy of this surgical method needs to be confirmed with rigorous clinical research.

The validation and development of the DSO surgical technique are still in progress. Several surgical steps are under debate, including the most effective determination of the descemetorhexis zone. Numerous studies have verified that the diameter of the descemetorhexis zone and the central 4 mm diameter area of the descemetorhexis zone show favourable surgical outcomes. However, to our knowledge, no studies have clarified the characteristics of the descemetorhexis zone based on each patient’s individual lesions. Lesion size and location may differ among individuals, and an oversized diameter of the descemetorhexis zone may lead to a reduction in endothelial cells. Herein we present a visualization technique for

Fig. 1 — Trypan blue-assisted detection in Descemet’s stripping only: (A) the anterior chamber is filled with 0.06% trypan blue dye; (B) the excess trypan blue dye is washed out with a balanced salt solution. The lesion is clearly stained and well defined. (C) The corneal epithelium is removed to enhance visibility.
implementing DSO using trypan blue dye, which reduces excessive endothelial loss.

A 2.4 mm temporal corneal incision was made after local anaesthesia, and a 1 mm side port incision was created. Trypan blue (0.06%; Vision Blue; DORC International, Zuidland, Netherlands) was injected directly into the anterior chamber to distinguish the descemetorhexis zone (Fig. 1A), followed by a washout with a balanced salt solution (Fig. 1B). Scraping of the central corneal epithelium was performed to enable visualization (Fig. 1C). The damaged endothelial cells and stained Descemet's membranes were stripped with a reverse Sinskey hook.

We report on the use of a simple technique (trypan blue-aided DSO) to detect a diseased corneal endothelium. This technique can be justified via precise examination using cornea—anterior segment optical coherence tomography (AS-OCT; Casia 2, Tomey, Nagoya, Japan). In the profiled case, the lesion was thoroughly delineated with trypan blue and corresponded to the corneal pachymetry data map measured using AS-OCT (Fig. 2A–C). This simple technique offers highly selective staining of damaged cells and tissues, thereby limiting excessive peeling of the endothelium.

Trypan blue is an azo dye commonly used as a vital stain for selecting dead cells and tissues. Trypan blue is used because of its anionicity and hydrophilicity, making intact cell membranes impermeable to it.3 Thus we were only able to stain compromised endothelial cells, the bare Descemet's membrane, and the guttae. Trypan blue dye was selected in this case because our medical group had previously performed trypan blue-aided Descemet's stripping automated endothelial keratoplasty to treat bullous keratopathy.
In the present case, almost all Descemet’s membranes were stained with trypan blue because of the large number of damaged cells (Fig. 3).

In contrast to the aforementioned bullous keratopathy case, our case (presenting with FECD) underwent trypan blue staining only in the central ocular area. This indicates the high selectivity of the trypan blue dye. Our technique indicated a stained area within 4 mm, which has been the most successful size for the descemetorhexis.\(^1\) Therefore, patients with a descemetorhexis zone >4 mm should be considered for endothelial keratoplasty because of the poor migration of endothelial cells.

The high concentration of guttae in the central area could be measured with the assistance of digital technology; however, guttae also can be detected using retroillumination (manual measurement). A recent study conducted in Singapore showed that manual measurement of guttae was less accurate than automated measurement in counting the number of guttae, showing a distribution of guttae density with larger guttae located in the central area.\(^4\) This indicates that the large guttae, that is, the high-density area of guttae, were stained intensively, allowing for identification of the compromised area.

The safety of trypan blue has been investigated in prior research, with studies consistently demonstrating that this dye is not significantly toxic to the corneal endothelium when injected directly into the anterior chamber. Furthermore, trypan blue may have stained the fibrillar layer, which, along with guttae, has been shown recently to be a progressive indicator of FECD.\(^3\) Therefore, trypan blue dye may assist in determining the descemetorhexis zone, including the fibrillar layer, more reliably.

Additional studies are necessary to investigate the efficacy of our technique in a large number of patients and in patients with different clinical backgrounds, including those with decreased peripheral endothelial cell counts. Long-term observations within case reports, case series, and rigorous clinical research are necessary to inform medical guidelines and for effective clinical decision making.

*Fig. 3—Comparison with a case of bullous keratopathy who underwent Descemet’s stripping automated endothelial keratoplasty using trypan blue. This image clearly shows the stained Descemet’s membranes and denuded area, indicating that all Descemet’s membranes are stained with trypan blue.*
In conclusion, this simple technique appears to be a reasonable and effective approach for evaluating the size of the descemetorhexis zone when performing DSO. Our findings provide future research directions and directly contribute to informing medical guidelines and clinical decision making.

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