CASE REPORT

In-vivo expansion of autologous limbal stem cell using simple limbal epithelial transplantation for treatment of limbal stem cell deficiency

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SUMMARY

A 20-year-old man from Bangladesh suffered accidental alkali injury to his right eye in May 2010 leading to total limbal stem cell deficiency. An amniotic membrane graft was performed 5 days after the accident and the patient presented to our institute 6 months later. On ocular examination, his best corrected visual acuity (BCVA) was 20/50 with a 360° pannus at the periphery and central area was spared but had stromal scarring. He underwent simple limbal epithelial transplantation (SLET) taking a limbal biopsy from his left eye and was prescribed steroid and antibiotic eye drops postoperatively as per the standard regimen. At 2 year follow-up, the patient's ocular surface is stable with improvement in BCVA to 20/25 post-SLET.

BACKGROUND

Corneal blindness due to ocular burns was once considered as incurable with very poor outcome for corneal transplantation. In recent years, our understanding regarding this complex entity has improved and a variety of treatment modalities are now available for the management of such conditions. The algorithm for management of limbal stem cell deficiency (LSCD) depends on whether the condition is unilateral or bilateral and involves some or all of the limbal stem cells. Unilateral cases with total LSCD may benefit from either a conjunctival limbal autograft (CLAU), or transplantation of cultured limbal stem cells (CLET) from the fellow eye, or from a living-related donor in a one-eyed patient. More recently a simple limbal epithelial transplantation (SLET) technique has been described for limbal stem cell transplant.¹ This technique incorporates the advantages of CLAU and CLET by being a single-stage procedure, easily affordable without requirement of a laboratory and the associated cost and requires minimal donor tissue. We reported early results of SLET which are quite encouraging. This case report illustrates the 2 year outcome which is the longest follow-up with this technique.

CASE PRESENTATION

A 20-year-old man from Bangladesh presented to us on 12 November 2010 with diminution of vision, monocular diplopia and dryness in the right eye following alkali injury with floor cleaner 6 months back. He underwent amniotic membrane graft (AMG) elsewhere 5 days after the accident and he was using antibiotic, steroid, antihistaminic and lubricating eye drops. There was no other significant ocular or systemic history. On ocular examination, his left eye was within normal limits with a

best corrected visual acuity of 20/20 parts with −1 dioptre cylinder at 30° for distance and N6 for near at 30 cm. His visual acuity in right eye was 20/100 improving to 20/50 and the near acuity was N12. The intraocular pressure was 12 and 13 mm Hg for right and left eye respectively. On slit-lamp examination of the right eye, the lids were mildly oedematous and the cornea revealed 360° scarring with conjunctivalisation at the periphery with a residual AMG in the centre (figure 1). The anterior chamber was deep with a round reacting pupil and a clear lens. Dilated fundus examination was within normal limits with a cup disc ratio of 0.3:1 both eyes with a healthy neuroretinal rim. Based on the above findings, a diagnosis of total LSCD (status post-AMG for alkaline injury) of the right eye and simple myopic astigmatism in the left eye was made. He underwent simple limbal epithelial transplantation of the right eye using a limbal biopsy from the left eye on 4 November 2010. The histopathological report was consistent with our findings of a fibrovascular pannus. On first postoperative day, the patient was doing well, AMG and bandage contact lens (BCL) in place and a healthy donor site (figure 2). He was prescribed antibiotic eye drops four times a day for two weeks and steroid eye drops 2 hourly which were gradually tapered over the next few months. The donor eye was prescribed antibiotic and steroid eye drops for 2 months. The patient came for regular follow-up to our institute at day 1, and 5, week 2, month 2 and 6, and year 1 and 2. On his last follow-up visit on 9 February 2013, his visual acuity in right eye was 20/32 improving to 20/25 with +0.50 dioptre sphere and −2.5 dioptre cylinder at 140° and 20/20 left eye. The intraocular pressure was 14 and 13 mm hg in right and left eye respectively. On slit-lamp examination of the right eye, the central cornea was clear, with tiny symblepharon present supero-temporally and a pannus in the superior and inferior quadrant at 6'o clock (figure 3). The rest of the examination was within normal limits. The patient was satisfied with the outcome and glasses were prescribed for his distance vision.

DISCUSSION

The ocular surface is maintained by a steady supply of epithelial cells from the limbus at the periphery. The surface epithelial cells are desquamated and replaced by proliferating basal epithelial cells from the periphery. This state of dynamic equilibrium is maintained by the limbal stem cells, residing within the palisades of Vogt. The limbal stem cells are responsible for corneal

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Figure 1 (A) Diagrammatic representation of cornea of right eye preoperatively illustrating 360° pannus with a clear central cornea. (B) Preoperative scanned diagram of the right eye.

epithelial renewal and regeneration, and also function as a barrier, preventing conjunctival epithelium from growing onto the cornea. Therefore, in cases of LSCD, there is conjunctivalisation associated with chronic inflammation.

Various treatment modalities are available today for treatment of unilateral total LSCD. Conjunctival limbal autograft was first introduced by Kenyon and Tseng² and involved transplantation of large annular segments of conjunctival tissue containing limbal stem cells from a healthy donor eye to the affected eye. However, donor site complications were reported by several

Figure 2 (A) Immediate postoperative slit lamp photograph of right eye showing the tiny explants with amniotic membrane in situ. (B) High magnification view.

Figure 3 (A) Clinical photograph of right eye at 2 year follow-up showing a stable ocular surface with a pannus at 11 o'clock and 6 o'clock. (B) Slit-lamp photograph of left eye at 2 year follow-up demonstrating a healthy donor site.

groups, raising concerns regarding the safety of this procedure. The next big step in corneal epithelial regeneration was the development of an ex-vivo cultivated technique of limbal transplantation described by Pellegrini *et al.*³ In this technique, a sheet of cultivated limbal epithelium could be produced in the laboratory from a small limbal biopsy, reducing the surgical trauma to the donor eye and consequent complications. The clinical success is reported in 68–80% of cases in various case series by different authors^{4–6} but the major limiting factor for this technique is the cost required for setting up the laboratory and the patient has to come twice for the surgery. Recently, a new technique was developed which combined the advantages of both the procedures without the difficulties of either and was called SLET.¹ This is a single stage procedure performed under peribulbar anaesthesia. A 2×2 mm limbal tissue is harvested from the superior quadrant of a healthy fellow eye and the conjunctiva is repositioned back using fibrin glue. A 360° conjunctival peritomy is performed and the fibrovascular pannus is dissected from the recipient eye. After minimal cauterisation of the bleeding points, human AMG is placed over the bare ocular surface and secured with fibrin glue. The limbal tissue from the donor eye is then gently held with Lim's forceps and cut into 8–10 small pieces with either Vannas scissors or a No 15 surgical blade. The tiny transplants are then placed on the AMG and distributed in a circular fashion around the centre of the cornea. The transplants are fixed in place with fibrin glue. A soft bandage contact lens is placed on the recipient eye, and one drop of 2.5% povidone-iodine is instilled in both eyes, followed by overnight patching. The patients were put on steroid and antibiotic eye drops for both eyes and the steroids were gradually tapered off. Sangwan *et al* reported a completely epithelialised, avascular and stable corneal surface achieved by 6 weeks and maintained in all recipient eyes at a mean follow-up of 9 months in their case series. None of the donor eyes suffered any complication and epithelialised in all 6 eyes in 14 days. These results have encouraged us to report this case as long-term follow-up for these cases is warranted to validate this study.

Learning points

- ▶ Simple limbal epithelial transplantation (SLET) is a novel new technique for treatment of cases with unilateral total limbal stem cell deficiency.
- ▶ The donor site is free of complications as less amount of tissue is harvested.
- ▶ Two-year follow-up of our case showed excellent results with improvement in visual acuity as well as stabilisation of ocular surface.
- ▶ We feel that SLET should now be renamed as in-vivo expansion of limbal stem cells using SLET.

Contributors All the authors have contributed equally to the manuscript.

Competing interests None.

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