The Adjunct Use of Dehydrated Amniotic Membrane (AmbioDry™) For the Treatment of Ocular Chemical Burn

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PURPOSE

To report the use of dehydrated amniotic membrane tissue in the reconstruction of the anterior ocular segment of a severe chemical burn patient.

A 42-year-old man, with an eight-year history of a chemical burn from industrial lye in his left eye, had severe upper eyelid cicatricial damage, along with stage 4 symblepharon, due to the chemical injury and the depletion of epithelial stem cells. Besides the significant visual debilitation of LP vision, the patient for the last seven years had severe symptoms of erythematous ocular surface, continued tearing, irritation and of course poor cosmesis (Photo 1).

The extensive procedure on the left eye was performed with peribulbar anesthesia. Initially, symblepharon lysis was performed, removing all the cicatricial tissue from the anterior bulbar surface and the palpebral conjunctival surface. A penetrating keratoplasty was then performed with a placement of the corneal graft of 8mm diameter onto a 7.5mm host trephination, with 16 interrupted 10-0 nylon sutures. During the PK procedure, significant cataract formation was noted. A cataract procedure with intraocular lens implantation was performed concomitantly.

Subsequently, two conjunctival-limbal autografts, harvested from the healthy right eye, were sutured into place superiorly from 11 to 1 o’clock and inferiorly from 5 to 7 o’clock with four 10-0 nylon sutures.

Finally, a 2x3 cm dehydrated amniotic membrane (AmbioDry™) was fashioned over the cornea as an overlay graft with graft coverage beyond the perimeter of the penetrating keratoplasty. The graft was placed on the eye in its dry state (Photo 2) and secured into place by hydration with BSS. In order to maintain stability of the amniotic membrane graft at the site, an 18mm diameter bandage contact lens was positioned.

The patient was placed on topical corticosteroid and antibiotic treatment, as well as oral Ciclosporine A. Immediately postoperatively, the patient regained significant vision. His preoperative visual acuity as noted above was light perception, and postoperatively at 3 months, he was evaluated to be 20/40 without correction, and 20/30 with pinhole.

At three-month follow-up, the patient appears to have a clear graft (Photo 3). The conjunctival-limbal autografts have stabilized and the amniotic membrane has resolved. The patient will continue oral Ciclosporine A for approximately three additional months (a total of six months prescription), followed by a taper period. Creatinine levels are monitored during this interval. The subject remains a high-risk corneal transplant patient. Visual prognosis at this point is very good.

CONCLUSION

Historically, preserved and fresh amniotic membrane has been utilized to promote ocular epithelialization, to suppress inflammation and pain, and to reduce angiogenesis in defected ocular surfaces. In this case, dehydrated amniotic membrane was found to be an effective, adjunct material in inducing and supporting such healing mechanisms.
DISCUSSION

Human amniotic membrane transplantation has been increasingly used in order to rehabilitate patients with external diseases originating from limbal stem cell dysfunction and/or deficiency, and conjunctival stem cell dysfunction and/or deficiency. The proposed mechanisms of action of these clinical results with amniotic membrane transplantation has been: first, the basement membrane of the amniotic membrane provides a “fertile” scaffold for growth of epithelial cells. The amniotic membrane acts as a “promoter” of the multiplication of cornea and conjunctival cells, resulting in a quicker reconstruction of the ocular surface. This would be important in this group of patients where the grafted progenitor cornea stem cells are expected to re-populate the deficient external surface damaged by previous chemical injury.

Another mechanism of action has been proposed to be that the amniotic membrane appears to contain antifibrocytic factors that seem to have a significant beneficial effect in scar reduction and ocular surface healing. This may be another significant principle regarding the evaluated group of patients. Ocular surface deficiency and inadequate lubrication along with significant tissue damage from the preceding chemical injury had resulted in significant anterior cornea scarring and conjunctival cicatrization in these patients. As a result they suffered from significant visual compromise in the injured eye, along with the other indirect sequela anterior surface cicatrization and scarring such as tricasis, secondary ptosis and poor cosmesis.

We have seen significant scar reduction in previous cases as well as the one presented herein associated with autologous limbal cornea stem cell transplantation. The combined procedure evaluated herein may have benefited these patients in the three following ways:

1. Careful removal of superficial scar and cicatrix resulted in more regular surface, that became more sufficiently lubricated postoperative.
2. Cornea stem cell transplantation, by re-populating the anterior cornea and conjunctival surface has prevented further cicatrization and scarring as shown in other similar previous studies.
3. The addition of amniotic membrane has complemented the reconstruction process in the early postoperative weeks by protecting the grafted autologous epithelial tissue, by providing a scaffold for surface re-population as noted previously and preventing further scar formation by its anti-fibrocytic properties.

The amniotic membrane in these cases, combined with limbal cornea stem cell autotransplantation appeared to improve the ocular surface and significantly reduce the anterior corneal scarring with the beneficial effect of significant visual rehabilitation in these patients. In these cases where penetrating keratoplasty was performed as well, visual rehabilitation was partly achieved by the transparency of the donor cornea button, and partly by the improvement of the ocular surface.

The amniotic membrane in the early postoperative days and weeks, may act as a biological “bandage”, allowing for significant healing to occur under optimized moisture environment in these dysfunctional ocular surfaces. In the two to three weeks that the amniotic membrane is present over the ocular surface, it does appear to play the role of a temporary biological “bandage”, allowing for significant healing and surface reconstruction to take place before the operated surface is exposed to evaporation of aqueous tear components as well as mechanical friction with the palpebral conjunctiva, the eyelid margin, and/or cilia (in patients that have coinciding trichiasis). In some of these patients, the cicatrization of the palpebral conjunctiva resulted in significant reduction of vertical palpebral fissure shortening. As mentioned in this prospective study, all cases received palpebral conjunctival fornix reconstruction. This included surgical lysis of all symblepharon cicatrizal bands, and covering of the bulbar and palpebral conjunctival surface with amniotic membrane. Our assessment was that this measure prevented symblepharon formation and allowed enough time for the grafted epithelial tissue to re-populate the fornical surface with better long term result.

Fornix reconstruction appeared to improve post-operatively upper and lower eyelid mobility, and a more symmetric vertical palpebral fissure, when compared to the contralateral healthy eye. The beneficial results of the combined amniotic transplantation in these patients are nevertheless limited by the small number of cases, as well as the lack of a control group, were unilateral chemical burn is treated by limbal cornea stem cell autografts alone.
Human amniotic membrane transplantation, combined with limbal cornea stem cell autotransplantation, appears to offer significant improvement in ocular surface disease, significant visual acuity improvement. Further studies and certainly studies including a control group could provide more information regarding the efficacy of human amniotic membrane transplantation in similar disorders.

REFERENCES

Dr. Kanellopoulos is an eye surgeon specializing in Cornea Transplantation, complicated Glaucoma, and Refractive surgery. His background includes Medical school training at Southern Illinois University, and Residency training at the State University of New York at Stony Brook / Nassau County Medical Center. He has sub-specialized in External Diseases, Cornea and Refractive surgery with Fellowship training at Cornell University Medical College and Harvard Medical School. He has sub-specialized in Glaucoma surgery with Fellowship training at Harvard Medical School.

His Academic career includes appointments as an Assistant in Ophthalmology at Harvard Medical School, Clinical Instructor at Cornell University Medical College, Assistant Professor of Ophthalmology at the State University of New York at Brooklyn, and attending staff surgeon at the Cornea Service at Manhattan Eye, Ear and Throat Hospital. He is currently an Associate Clinical Professor with the Department of Ophthalmology at the New York University Medical School.

Dr. Kanellopoulos is in private practice limited to cornea transplantation, laser refractive surgery, laser cataract surgery and complicated glaucoma surgery in Athens, Greece and also in New York City. He has been a regular clinical consultant in Cornea, Refractive, and Cataract surgery for several international sites in Europe and the Middle East. His bibliography includes over 40 original papers in peer review journals, several book chapters, and multiple American Academy of Ophthalmology annual meeting presentations.