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Amniotic membrane graft as a biological contact lens in treatment of corneal epithelial defects and stromal ulcers

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Prolonged inflammation of the ocular surface causes destruction of corneal stem cells that can result in corneal epithelial defect and/or sterile corneal ulcer. Such surface disorders further exacerbate chronic inflammation that can lead to corneal scarring with or without neovascularization. Moreover, collagenases produced by keratocytes and polymorphonuclears cause progressive corneal thinning with a potential risk of corneal perforation and loss of the eye.

Previous studies showed that the basement membrane facilitates migration of epithelial cells, reinforces adhesion of basal epithelial cells, promotes epithelial differentiation, and prevents epithelial apoptosis. When the barrier function of the limbus is compromised due to severe limbal stem cell deficiency, corneal surface can be transplanted by conjunctival epithelium that can acquire a corneal-type phenotype in the presence of intact basement membrane.

Amniotic membrane is composed of one epithelial cell layer, basement membrane, and avascular matrix. It has been shown that the amniotic membrane contains structural components, including a basement membrane, as well as growth factors that promote healing of epithelial defects. Collagen IV, a component of corneal epithelial basement membrane, is also present in the stroma of amniotic membrane. The amniotic membrane epithelium produces basic fibroblast growth factor, hepatocyte growth factor, and transforming growth factor after transplantation on the corneal surface. Additionally, Matrix metalloproteinases have also been identified in the human amniotic membrane.

In 1910, Davis first reported the use of the amniotic membrane in human medicine in the English literature. He utilized a living amniotic membrane as a graft for skin transplantation. Since then, living rather than preserved amniotic membrane has been used in various

areas of human medicine. In 1940, De Roth first reported the use of amniotic membrane in the eye. He used a living amniotic membrane to reconstruct conjunctival defects. In 1995, Kim et al.¹ experimentally demonstrated that the use of a preserved amniotic membrane graft is effective for corneal surface reconstruction in rabbits following epithelial removal and limbal lamellar keratectomy. Their results encouraged others to perform clinical studies.

We retrospectively reviewed the charts of 12 patients (12 eyes) who underwent amniotic membrane transplantation for persistent corneal epithelial defects and/or stromal ulcers lasting one to six weeks.

The procedure was performed as follows: Human amniotic membrane graft was prepared and preserved as described in previous studies. After retrobulbar anesthesia, the base of the epithelial defect or stromal ulcer was debrided using a micro-sponge, and poorly adherent epithelium surrounding the defect or ulcer was removed. The amniotic membrane was peeled from the nitrocellulose filter paper, placed over the entire corneal surface and adjacent conjunctiva, and secured to the perilimbal conjunctiva with interrupted 10-0 Vicryl sutures. At the end of the procedure, a bandage contact lens was applied. Postoperatively, antibiotic and corticosteroid drops were administered four times daily. The bandage contact lens was removed after healing of the epithelial defect or stromal ulcer, usually at two weeks, by which time the amniotic membrane had dissolved.

Our results were favorable. The average visual acuity before and after the surgery was 0.03 (range 0.01 to 0.13) and 0.05 (range 0.01 to 0.2), respectively ($P=0.15$). The average healing time of the corneal epithelial defect or stromal ulcer was 6.8 weeks (range 2 to 22) after surgery. At the time of surgery, eight patients (67%) were receiving immunosuppressive treatment for an underlying autoimmune disease associated with epithelial defect or stromal ulcer. In eleven eyes (92%) the epithelial defect or stromal ulcer healed after the first amniotic membrane transplantation. In one eye, the epithelial defect did not respond to the first amniotic membrane transplantation. The epithelial defect or stromal ulcer healed and remained stable without an episode of recurrence in six eyes (50%). During the follow-up time, recurrence of the epithelial defect or stromal ulcer occurred in five eyes (42%). The recurrence episode of epithelial defect or stromal ulcer was successfully treated with bandage contact lens in all but two patients. Keratoprosthesis was indicated in both cases. In 8 eyes, the amniotic membrane transplantation was associated with additional surgical procedures. These included: superficial keratectomy (2 eyes), limbal stem cell transplantation (2 eyes), tarsorrhaphy (1 eye), superficial keratectomy and tarsorrhaphy (1 eye), conjunctival biopsy (1 eye), and fornix reconstruction (1 eye). Eight

patients (75%) were receiving immunosuppressive treatment at the time of amniotic membrane transplantation for underlying autoimmune disease.

This study demonstrated the efficacy and safety of amniotic membrane graft transplantation for persistent epithelial defects and/or sterile corneal ulceration. Since then, amniotic membrane transplantation has increased significantly. This trend is likely attributable to the development of various surgical techniques, increased understanding of its content of growth factors, neurotrophins, and cytokines, and demographic changes associated with population aging.

Currently, amniotic membrane transplantation on the surface of the eye is used for ocular surface reconstruction in chemical burn, advanced ocular cicatricial pemphigoid and Stevens-Johnson syndrome, pterygium excision surgery, conjunctival surface reconstruction, and sterile corneal ulceration.

Current amniotic membrane implants are biological tissue grafts derived from the human placenta and are commonly used in ophthalmology for the conditions described earlier. They are available in cryopreserved (frozen) or dehydrated (dry) forms. These products include AmnioGraft®, Prokera®, AmnioGuard®, Omnigen®, OmniLenz®, AmbioDisk, and Ambio5™. These newer devices can be applied to the cornea in the office and remain in place without the need for sutures. Patients should be monitored weekly and maintained on prophylactic antibiotic therapy throughout treatment.

For more details, please review the references below.

References:

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