

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

C. Stephen Foster, M.D.

Introduction

Prolonged inflammation of the ocular surface causes destruction of corneal stem cells that can result in corneal epithelial defects or stromal ulcers. Such surface disorders further exacerbate chronic inflammation that can lead to corneal scarring and 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 persistent corneal epithelial defect develops as a consequence of severe limbal stem cell deficiency, corneal surface can be replaced 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 was shown that amniotic membrane comprises structures that improve healing of the epithelium defects, i.e. basement membrane and growth factors. Collagen IV, a component of corneal epithelial basement membrane, is present in the stroma of amniotic membrane. The epithelium of amniotic membrane produces basic fibroblast growth factor, hepatocyte growth factor, and transforming growth factor β . Amniotic membrane prevents inflammatory cell infiltration and reduces apoptosis in keratocytes after transplantation on the corneal surface. It is noteworthy, that matrix metalloproteinases were identified in human amniotic membrane as well.

In 1910, Davis first reported in English literature on use of amniotic membrane in human medicine. He used living amniotic membrane 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 on the use of amniotic membrane in the eye. He used living amniotic membrane for the reconstruction of conjunctival defects. In 1995, Kim et al showed experimentally that the use of preserved amniotic membrane graft is efficient in the corneal surface reconstruction in rabbits after epithelial removal and limbal lamellar keratectomy. These results encouraged others to perform clinical studies. Thus, amniotic membrane transplantation has been recently used for ocular surface reconstruction in patients after chemical burn, in patients with advanced ocular cicatricial pemphigoid and Stevens-Johnson syndrome, for pterygium excision, conjunctival surface reconstruction, and sterile corneal ulceration.

Patients and methods

The charts of 12 patients (12 eyes) who underwent amniotic membrane transplantation for persistent corneal epithelial defect or stromal ulcer between 1997 and 1999 were reviewed. The duration of corneal epithelial defects or stromal ulcers varied from one to six weeks. Human amniotic membrane grafts were prepared and preserved as described in a previous study.

After retrobulbar anesthesia, the base of the epithelial defect or stromal ulcer was debrided with a micro sponge, and the poorly adherent epithelium surrounding the defect or ulcer was removed. The amniotic membrane was peeled from the nitrocellulose filter paper, placed on the entire surface of the cornea and surrounding conjunctiva, and secured by interrupted 10-0 Vicryl sutures to the perilimbal conjunctiva. A bandage contact lens was applied at the end of surgery. Ciprofloxacin 0.35% eye drops four times a day and rimexolone 1% eye drops four times a day were administered in the postoperative period. The amniotic membrane dissolved under bandage contact lens over the period of two weeks after surgery. The bandage contact lens was removed when the epithelium defect or stromal ulcer was healed.

Results

The results are summarized in Table 1. The average age of the patients was 63.8 years (range 29 - 82). Male/Female ratio was 5/7. The average follow-up time was 3.3 months (range 1 to 11) after amniotic membrane transplantation. 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 11 eyes (92%) the epithelial defect or stromal ulcer healed after the first amniotic membrane transplantation. In one eye (8%) (No. 12), the defect persisted after 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 (No. 4 and No. 5). 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.