ORIGINAL ARTICLE

Total ocular surface amniotic membrane transplantation for paraquat-induced ocular surface injury

Ting Wang, MD, PhD, Changsen Liang, MD, Xiaohan Xu, MD, Weiyun Shi, MD, PhD

ABSTRACT • RÉSUMÉ

Objective: To evaluate the therapeutic efficacy of modified amniotic membrane transplantation (MAMT) for paraquat-induced ocular surface injury.

Design: Retrospective case series.

Participants: Thirty patients (30 eyes) with paraquat-induced ocular surface injury.

Methods: Among the patients, 8 underwent MAMT, 14 received conventional amniotic membrane transplantation (AMT), and 8 were treated with simple drug therapy (DT). Features related to the damage, corneal epithelial defect closure time, visual acuity, stromal haze, and complications were recorded.

Results: In the MAMT and AMT groups, visual acuity in all eyes recovered to the preinjury level; in the DT group, visual acuity in 3 eyes (37.5%) recovered to the preinjury level. The mean corneal epithelial defect closure time was 7.6 $\pm$ 2.7 days in the MAMT group, 9.8 $\pm$ 3.6 days in the AMT group, and 18.2 $\pm$ 5.2 days in the DT group ($p < 0.05$). There was a significant difference in the symblepharon rate after treatment among the 3 groups (MAMT: 0%, AMT: 35.7%, DT: 87.5%; $p < 0.05$). Although the tear secretion was reduced in all groups, it was significantly lower in the DT group compared with the MAMT and AMT groups ($p < 0.05$).

Conclusions: Paraquat-induced ocular injuries can lead to whole ocular surface damage. MAMT treatment in a timely manner can effectively promote the repair of the ocular surface and reduce the complications from symblepharon.

Objet : Évaluer l'efficacité thérapeutique de la greffe de membrane amniotique modifiée (GMAM) dans des cas de lésion de la surface oculaire causée par le paraquat.

Nature : Étude de cas rétrospective.

Participants : Trente patients (30 yeux) ayant une lésion de la surface oculaire causée par le paraquat.

Méthodes : Parmi les patients, 8 ont subi une greffe de membrane amniotique modifiée (GMAM), 14 ont reçu une greffe de membrane amniotique classique (GMA) et 8 ont été traités par pharmacothérapie. Ont été consignés les détails relatifs aux lésions, le délai de rétablissement de l'épithélium cornéen, l'acuité visuelle, la présence d'une opacification du stroma et les complications.

Résultats : Dans les groupes GMAM et GMA, tous les yeux ont retrouvé leur niveau d'acuité visuelle prélésionnel; dans le groupe traité par pharmacothérapie, 3 yeux (37,5 %) ont retrouvé leur acuité visuelle prélésionnelle. Le délai moyen de rétablissement de l'épithélium cornéen était de 7,6 $\pm$ 2,7 jours pour le groupe GMAM, de 9,8 $\pm$ 3,6 jours pour le groupe GMA et de 18,2 $\pm$ 5,2 jour pour le groupe traité par pharmacothérapie ($p < 0,05$). Les trois groupes affichaient des taux de symblépharon significativement différents après le traitement (GMAM: 0 %, GMA : 35,7 %, pharmacothérapie : 87,5 %) ($p < 0,05$). La sécrétion lacrymale a diminué pour tous les groupes, mais elle était beaucoup plus faible pour le groupe traité par pharmacothérapie que pour les groupes GMAM et GMA ($p < 0,05$).

Conclusions : Les lésions oculaires causées par le paraquat peuvent entraîner l'atteinte de toute la surface oculaire. Réalisée sans délai, la GMAM peut favoriser la réparation de la surface oculaire et réduire les complications associées au symblépharon.

Paraquat, a fast-acting sterilant herbicide widely used in agriculture, is among the most common causes of chemical eye injury. After a splashing incident, paraquat can cause severe ocular damage, including epithelial defect, pannus, symblepharon, ankyloblepharon, trichiasis, entropion, and punctual stenosis.[1–4]

Two types of treatment, medication[2,5] and amniotic membrane transplantation (AMT), have been previously reported.[5–7] AMT treatment can shorten the time required for epithelial defect closure compared with medication treatment, but it cannot prevent symblepharon and ankyloblepharon in severe cases.

In this study, we observed a total conjunctival pseudomembrane at the acute phase of damage. When the pseudomembrane detached, symblepharon gradually formed after medication or AMT treatment. Therefore, we carried out modified AMT (cornea, fornix, and palpebral conjunctiva total ocular surface AMT) to treat paraquat-induced ocular injury. Our data showed that MAMT treatment can effectively promote the repair of the ocular surface and reduce the complications from symblepharon.

METHODS

Patients

Thirty patients (30 eyes) with acute, severe chemical eye injury caused by paraquat were retrospectively studied at Shandong Eye Hospital from January 2009 to December 2012. The diagnosis was made on the basis of the clinical

From the Shandong Eye Hospital, Shandong Eye Institute, Shandong Academy of Medical Sciences, Qingdao, China

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Correspondence to Weiyun Shi, MD, Shandong Eye Institute, 5 Yanerdao Road, Qingdao 266071, China; weiyunshi@163.com

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features of paraquat-induced ocular chemical injuries. All patients suffered corneal epithelial defect and conjunctival pseudomembrane. All patients received drug therapy (DT). In addition, 8 patients (8 eyes) also underwent modified amniotic membrane transplantation (MAMT; cornea, bulbar conjunctiva, palpebral conjunctiva, and fornix AMT) after January 2012 (the MAMT group). Fourteen patients (14 eyes) also received conventional AMT treatment between March 2010 and December 2011 (the AMT group), and 8 patients (8 eyes) received only DT treatment between January 2009 and February 2010 (the DT group). This study was approved by the Ethics Committee of Shandong Eye Institute.

Surgical techniques and medication treatment

Amniotic membrane transplantation surgical technique. The amniotic membrane was tiled on the surface of the cornea so that the conjunctiva with the epithelial surface was facing up. An amniotic membrane patch was sutured onto the surface to cover the entire cornea with continuous 10–0 nylon sutures placed 1 and 5 mm away from the corneal limbus.

Modified amniotic membrane transplantation surgical technique. The pseudomembrane was removed with the use of a surgical microscope. The congestive conjunctiva was exposed, and the symblepharon was separated. The amniotic membrane was tilted on the surface of the cornea so that the conjunctiva with the epithelial surface was facing up. A single 10–0 running nylon suture was used to fasten a circle 1 and 5 mm away from the corneal limbus. After the upper and lower eyelids were opened, interrupted 10–0 nylon sutures were used to secure the amniotic membrane near the fornix. Finally, the amniotic membrane was secured to the upper and lower palpebral conjunctiva with 10–0 nylon sutures using a variable combination of interrupted and running suture techniques depending on the surgeon's preference (Fig. 1).

Postoperative care. TobraDex eye drops (Alcon, Fort Worth, Tex.) and artificial tears were used 4 times daily after surgery. After the dissolution of the amniotic membrane, the dosage and the frequency of drug usage could be gradually reduced, and the sutures could be removed at the surgeon's discretion.

In the DT group, TobraDEX eye drops and artificial tears were also used 4 times daily. Glucocorticoids were given to reduce inflammation and promote the recovery.

Observational index and statistical analysis

Slit-lamp microscopy was used preoperatively to observe the features of the damage to the eyelid margin, conjunctiva, and cornea. Visual acuity, ocular surface recovery, and the Schirmer test were recorded.

The Statistical Package for Social Science 17.0 was used for statistical analysis. To rule out observation bias, we performed comparisons among the MAMT group, the AMT group, and the DT group with respect to general conditions such as age, sex, and the time of seeking medical advice. The significance of the differences was determined by the χ^2 test. Categorical data were compared with the Fisher exact test. Differences were considered statistically significant if $p < 0.05$.

Results

Among the 30 patients (30 eyes) with paraquat-induced ocular surface injury, 21 were males and 9 were females. There was no difference among the 3 groups in demographic features, the length of the injury history, and the size of epithelial defect (Table 1). The features of the damage at the acute phase were as follows: (A) palpebral edema, hyperemia, and obstruction of meibomian gland orifices; (B) conjunctiva congestion and edema, and conjunctiva (including palpebral conjunctiva, bulbar conjunctiva, and fornix conjunctiva) covered with pseudomembrane; and (C) corneal epithelial defect with cornea edema (Fig. 2).

Treatment outcome

In all cases, the epithelial defect was fully recovered within the follow-up period. The average healing time was the shortest in the MAMT group compared with the other 2 groups ($p < 0.05$). The incidence of haze was lower in

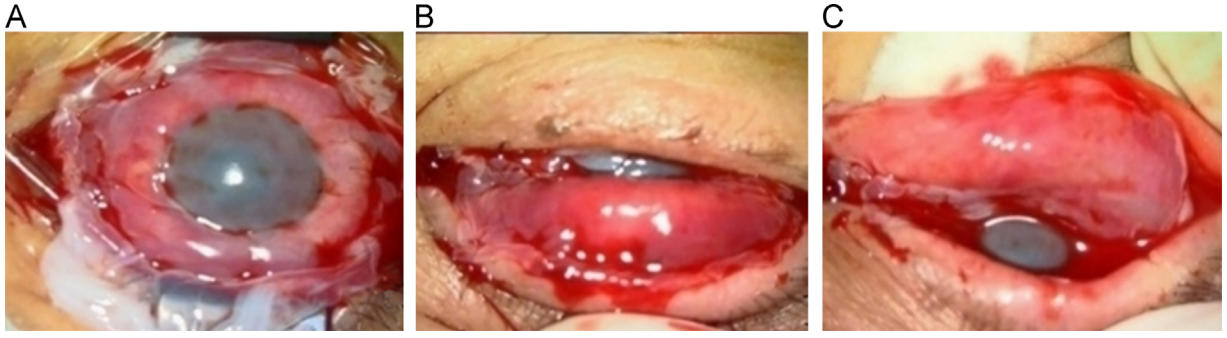

Fig. 1—A, Amniotic membrane was tiled on the surface of the cornea. B and C, The upper and lower eyelids were opened, and 10–0 nylon interrupted sutures were used to secure the amniotic membrane near the fornix to the upper and lower palpebral conjunctiva.

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