Sequels, Complications and Management of A Chemical Burn Associated with Cement Splash

Gerald C S Lim, MD; Lung-Kun Yeh, MD; Hsin-Chiung Lin, MD;
Samuel Chao-Ming Huang, MD

We present a case of successful superficial keratectomy and amniotic membrane grafting to re-establish ocular surface from denuded stroma and significant limbal ischemia caused by a cement splash. We fully documented a case report about the sequels, complications and management strategies of a chemical burn to the eyes associated with a cement splash. Slit lamp examination, visual acuity test as well as all common cultures and stains were performed to measure the outcome. Visual acuity significantly improved from 0.2 to best-corrected visual acuity 0.7 at the 5-month postoperative visit. The cornea regained its clarity. Total re-epithelialization of the injured area was observed. It is of primary importance to remove all the debris from a cement splash at the first available opportunity. Superficial keratectomy and amniotic membrane grafting may be the best methods for the re-epithelialization and reconstruction of the ocular surface. *(Chang Gung Med J 2006;29:424-9)*

Key words: cement, chemical burn, stroma, amniotic membrane grafting.

In general, alkali injuries to the eyes cause more significant damage than those caused by acids. Alkalis are water-soluble substances that release hydroxyl ions and have a basic pH in solution. On the ocular surface, they saponify cell membranes and intercellular bridges, which facilitate rapid penetration into the deeper layers and into the aqueous and vitreous compartments.[1] In addition, the severity of cell damage caused by alkaline agents depends on both the concentration of the alkali and the duration of exposure. In the corneal stroma, alkali cations cause damage and necrosis by binding to the mucopolysaccharides and to the collagen.[2, 3]

Calcium hydroxide, which is the main component of lime, plaster, mortar, cement, and whitewash, react with the epithelium cell membrane to form calcium soap that will reduce further penetration of the alkali. In comparison with other alkalis, it causes corneal opacification most rapidly as it will react with proteoglycan, and glycosaminoglycan to form an inextractable glycosaminoglycan chain.[3]

Amniotic membrane grafting and superficial keratectomy are often indicated to promote re-epithelialization. The cryopreserved human amniotic membrane contains a thick natural basement membrane and avascular stroma, which may provide the optimal microenvironment to allow epithelial cell proliferation and differentiation, and has been recently proposed as a new substrate in ocular surface reconstruction.

CASE REPORT

A 20-year-old man was referred to our corneal clinic at the Chang Gung Memorial Hospital for pain and decreased vision in his left eye due to a cement

Department of Ophthalmology, Chang Gung Memorial, Taipei
Received: Oct. 1, 2004; Accepted: Mar. 31, 2005
Correspondence to: Dr. Lung-Kun Yeh, Department of Ophthalmology, Chang Gung Memorial Hospital. 5, Fushing Street, Gueishan Shiang, Taoyuan, Taiwan 333, R.O.C. Tel.: 886-3-3281200 ext. 8666; Fax: 886-3-3287798; E-mail: lkyeh@ms9.hinet.net

splash 3 days prior to his visit. He had unremarkable history of his otherwise healthy eyes. In Figure 1, the picture shows the appearance of the eye 4 days after the cement splash, indicating a large area (about 180 degrees) of significant limbal ischemia with plenty of deposits of cement debris in the corneo-sclero-conjunctival complex. A large area of conjunctival epithelial defect with denuded stromal with elevated edge was seen under slit-lamp biomicroscopy examination. Due to the large area of defect in the corneo-sclero-conjunctival complex with plenty of deposits of cement debris, he was admitted to our ward for further management.

His best-corrected visual acuity was 1.0 in the right eye and 0.2 in the left eye. His intraocular pressures (IOPs) were 14 mmHg in the right eye and 21 mmHg in the left eye measured using applanation tonometry. Slit lamp biomicroscopy showed conjunctival epithelial defect with ischemic sign in the corneo-sclero-conjunctival complex with plenty of deposits of cement debris and 3+ anterior chamber cells (Fig. 1).

Fundus examination revealed normal fundus in both eyes. Initial treatment given included subconjunctival autoblood injection once every 3 days, one drop of sustained tears ophthalmic ointment (Duratears®, Alcon) once every 8 hours, one drop of 1% atropine (Wu Fu Lab. Co.) once every 12 hours, one drop of pure autoserum once every hour, one drop of Dexamethasone 1 mg/cc once every 6 hours, and one drop of Tobramycin ophthalmic solution (Tobrex®, Alcon) once every 8 hours. Oral medications prescribed included one capsule of 25 mg Indomethacin (Indocid®, Merck Sharp & Dohme) and Ditopax (Schering-Plough) analogue three times a day, one tablet of 100 mg doxycycline twice daily and one tablet of 200 mg ascorbic acid four times a day. No sign of re-epithelialization of the injured ocular surface was noted after a week of the above intensive medical treatment.

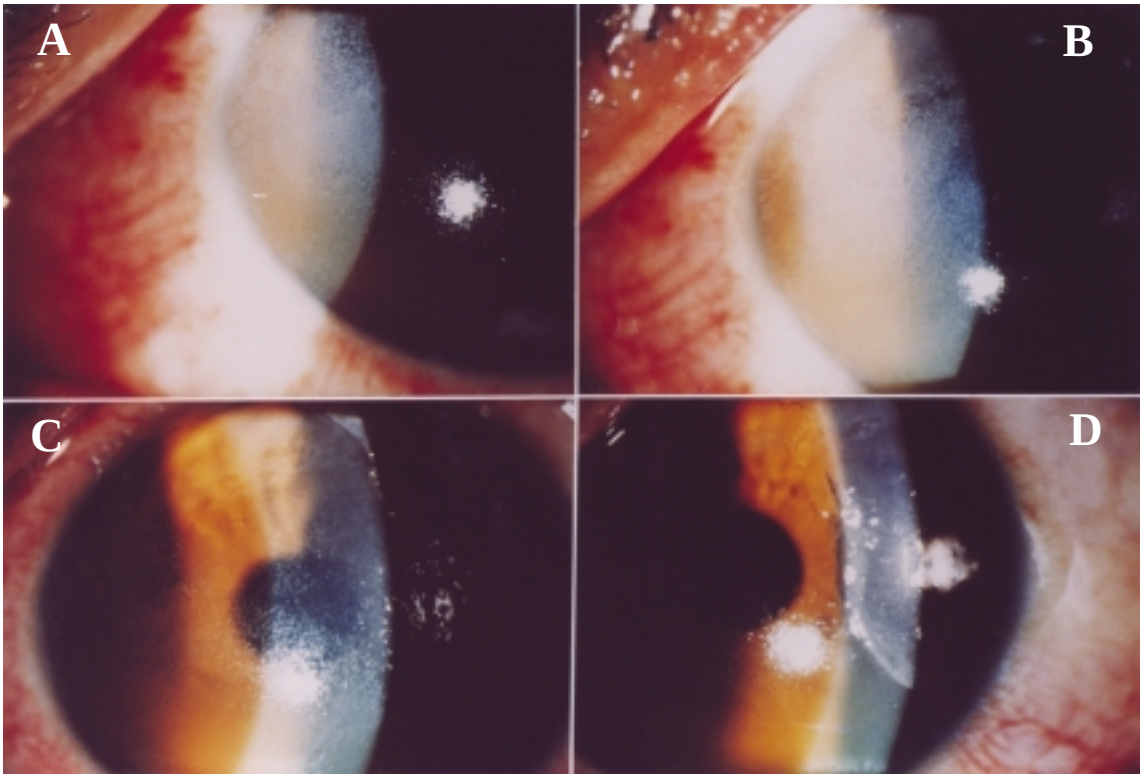

Fig. 1 The fourth day after cement splash in the left eye. (A) About 180 degrees of significant limbal ischemia with plenty deposit of cement debris in the corneal-scleral-conjunctival. (B) corneal opacification as calcium hydroxide react with proteoglycan and glycosaminoglycan to form inextractable glycosaminoglycan chain. (C) large area of epithelial defect with denuded stromal. (D) large area of epithelial defect with elevated edge.

Common aerobic culture, common anaerobic culture, fungus culture, mycobacteria culture, Gram's stain and Acid fast stain were performed. All of the cultures, stains and smears showed negative results.

During his stay in our ward, we attempted to debride the cement in the corneo-sclero-conjunctival complex area using a No. 15 knife on three different occasions. However, the reaction between the cement and the corneo-sclero-conjunctival tissue mentioned above made it impossible to remove the debris completely using superficial scraping. So, we performed superficial keratectomy and amniotic membrane grafting for this patient hoping to remove the cement totally and promote re-epithelialization of the corneo-sclero-conjunctival surface. In Figure 2, the condition of ocular surface 10 days after the cement splash is shown, reflecting re-epithelialization of the cornea and the conjunctiva. In Figure 3, the condition of the ocular surface 1 month after the cement splash and 3 weeks after the superficial keratectomy with amniotic membrane grafting is revealed. Clearing up of the corneal debris with faint stromal opacity was noted in the cornea. Four months after the cement splash, revascularization of the limbal area with further clearing up of the cornea with little debris remaining in the peripheral cornea was noted. Faint stromal opacity noted in cornea underwent remodeling and regression. The cornea regained its original clarity (Fig. 3).

The final outcome was quite satisfying for this patient. The best-corrected visual acuity was 1.0 in the right eye and 0.7 in the left eye. The cornea regained its clarity. Total re-epithelialization of the corneo-sclero-conjunctival injured area had occurred.

DISCUSSION

Moderately severe chemical burns, as in this case, are often associated with scattered blanching of the perilimbal conjunctival and episcleral vessels,

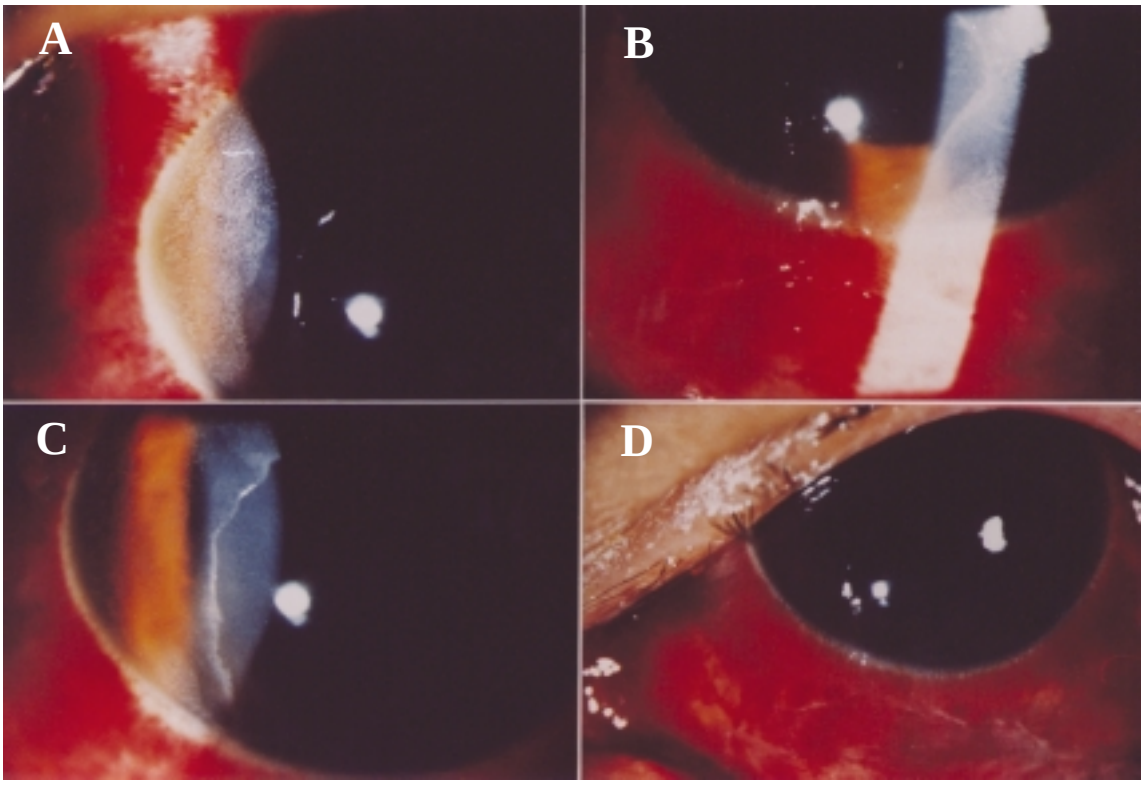

Fig. 2 10 days after cement splash in the left eye. (A) Post subconjunctival auto-blood injection. Remains of the inextractable glycosaminoglycan chain even after three sessions of debridement of the corneal stromal tissue using a no. 15 surgical knife.(B) Re-epithelialization of cornea noted. (C) Further re-epithelialization of cornea noted. (D) Total re-epithelialization of conjunctival noted. A patch of epithelial defect still can be seen in lower part of conjunctival.

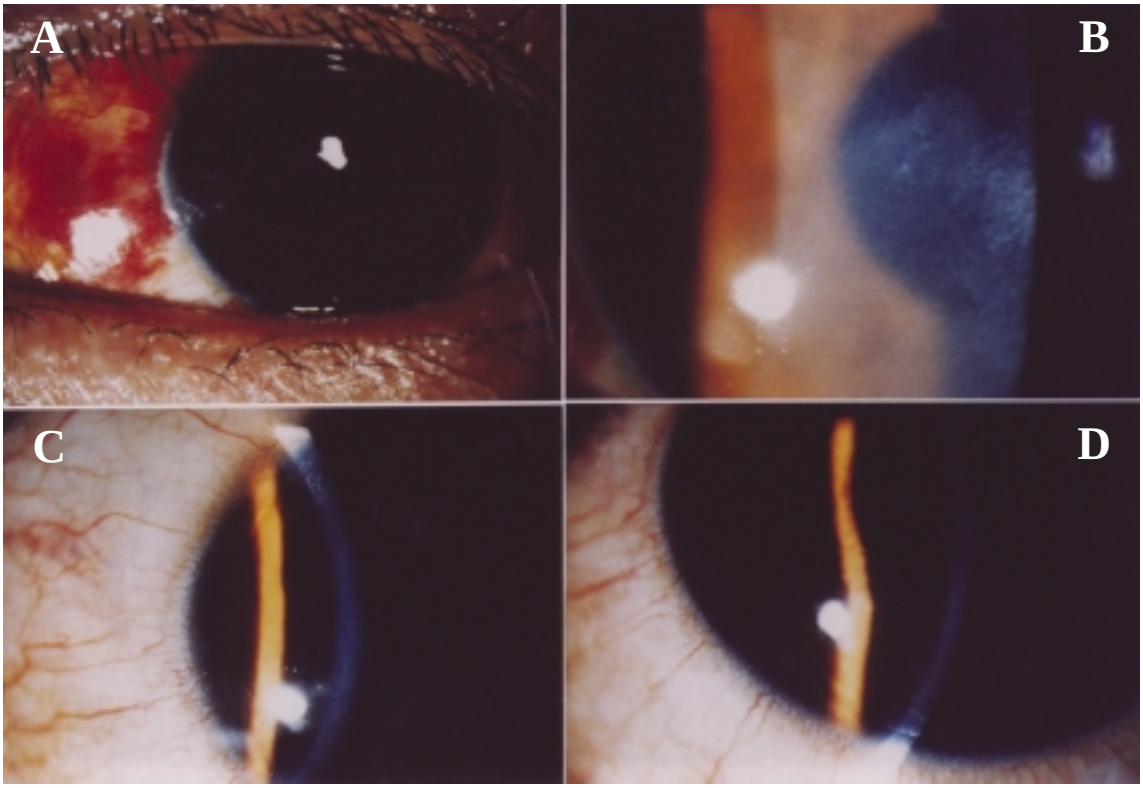

Fig. 3 1 month after cement splash and 3 weeks after superficial keratectomy with amniotic membrane grafting. (A) Clearing up of corneal debris. (B) Faint stromal opacity was noted in cornea. (C) Revascularization of limbal area noted. Further clearing up of cornea with little debris remained in peripheral cornea. (D) Faint stromal opacity noted in Fig. 3 (C) underwent remodeling and regression. Cornea regained its original clarity.

which exhibit no flow of blood through the thrombosed zones. The burnt eye of this patient with an intact Bell phenomenon exhibited the most damage along the lower limbus as the eye rolled upward in avoidance.[4]

We carried out every documented treatment options according to reports in the literature about chemical burns, namely: (1) irrigation; (2) debridement; (3) paracentesis; (4) antibiotics use; (5) cycloplegics use; (6) corticosteroids use; (7) 500 to 1000 mg ascorbic acid four times a day; (8) 100 mg doxycycline every 12 hours, which reportedly can prevent or significantly delay the ulceration of alkali-injured corneas by influencing collagen degradation;[5-10] (9) autologous or homologous serum use; (10) lysis of adhesions by glass rod; and (11) superficial keratoplasty.[14] None of the above measures produced a satisfactory outcome for this patient.

We emphasized the importance of the total removal of the cement material with deep lamellar debridement and amniotic membrane grafting as early as possible. The delay in recovery for this patient was mainly due to the deep penetration of the cement material that decreased the rate of re-epithelialization.

To promote re-epithelialization, the cryopreserved human amniotic membrane contains a thick natural basement membrane and avascular stroma, which may provide an optimal microenvironment to allow epithelial cell proliferation and differentiation. In addition, it has been recently proposed as a new substrate in ocular surface reconstruction such as in pterygium, symblepharon, conjunctivochalasis, scar, neoplasia, advanced chemical burn, Stevens-Johnson syndrome, ocular cicartrical pemphigoid, persistent epithelial defect and corneal ulcer.[11-13]

An amniotic membrane graft promotes epithelialisation and restores ocular surface without inflam-

mation and scarring. Amniotic membrane contains some protease inhibitors which indicate amniotic membrane has the function to reduce inflammation after application.[14]

The amniotic membrane (AM) contains basement membrane components and various proteinase inhibitors. Furthermore, when used as a graft, the basement membrane of AM could block inflammatory insults to a damaged corneal surface. Thus, amniotic membrane patching can promote the healing process by inhibiting proteolytic damage. Corneal opacity was the least significant when the amnion cell was side down.[15]

In conclusion, superficial keratectomy and amniotic membrane grafting may be one of the best methods to re-establish a protective covering of corneal epithelium over a denuded stroma that has not yet ulcerated as seen in our case.

REFERENCES

1. Arena JM. Treatment of caustic alkali poisoning. Mod Treat 1971;8:613-8.
2. Grant WM. Toxicology of the Eye, 2nd ed. Springfield, IL: Thomas 1974, p88.
3. Grant WM, Kern HL. Cations and the cornea; toxicity of metals to the stroma. Am J Ophthalmol 1956;42:167-81.
4. O'Donnell FE Jr, Hambrick GW, Green WR, Iliff WJ, Stone DL. X-linked ocular albinism: An oculocutaneous macromelanosomal disorder. Arch Ophthalmol 1976;94:1883-92.
5. Huang Y, Meek KM, Ho MW, Paterson CA. Anaylsis of birefringence during wound healing and remodeling following alkali burns in rabbit cornea. Exp Eye Res 2001;73:521-32.
6. Bazan HE, Tao Y. PAF antagonists as possible inhibitors of corneal epithelial defects and ulceration. J Ocul Pharmacol Ther 1997;13:277-85.
7. Tao Y, Bazan HE, Bazan NG. Platelet-activating factor induces the expression of metalloproteinases-1 and -9, but not -2 or -3, in the corneal epithelium. Invest Ophthalmol Vis Sci 1995;36:345-54.
8. Fini ME, Cook JR, Mohan R. Proteolytic mechanisms in corneal ulceration and repair. Arch Dermatol Res 1998;290:Suppl:S12-23.
9. Kosaku K, Maeda N, Yokoyama T, Inoue T, Yoshida Y, Hosokawa T, Sawa M. Effect of matrix metalloproteinase inhibitor on experimental pseudomonal corneal ulceration. Ganka Gakkai Zasshi 1998;102:717-23.
10. Ottino P, Taheri F, Bazan HE. Platelet-activating factor induces the gene expression of TIMP-1, -2, and PAI-1: imbalance between the gene expression of MMP-9 and TIMP-1 and -2. Exp Eye Res 2002;74:393-402.
11. Prabhasawat P, Barton K, Burkett G, Tseng SC. Comparison of conjunctival autograft, amniotic membrane graft, and primary closure for pterygium excision. Ophthalmology 1997;104:974-85.
12. Ma DH, See LC, Liau SB, Tsai RJ. Amniotic membrane graft for primary pterygium: comparison with conjunctival autograft and topical mitomycin C treatment. Br J Ophthalmol 2000;84:973-8.
13. Tsubota K, Satake Y, Ohyama M, Toda I, Takano Y, Ono M, Shinozaki N, Shimazaki J. Surgical reconstruction of the ocular surface in advanced ocular cicartricial pemphigoid and Stevens-Johnson Syndrome. Am J Ophthalmol 1996;122:38-52.
14. Espana EM, Prabhasawat P, Grueterich M, Solomon A, Tseng SCG. Amniotic membrane transplantation for reconstruction after excision of large ocular surface neoplasias. Br J Ophthalmol 2002;86:640-5.
15. Kim JS, Kim JC, Na BK, Jeong JM, Song CY. Amniotic membrane patching promotes healing and inhibits proteinase activity on wound healing following acute corneal alkali burn. Exp Eye Res 2000;70:329-37.

水泥混合物濺傷眼表層成功治療病例報告

林志雄 葉龍坤 林信瓊 黃朝銘

此報告提出一水泥混合物濺傷眼表層成功治療案例。水泥混合物濺傷眼表層屬於鹼性化學物灼傷。水泥混合物可引起眼角膜基質膠原纖維產生化學結構的改變成爲大分子的沉積物和水泥鈣化物嵌入眼角膜基質中。這些沉積物會造成眼角膜上皮壞死及眼角膜變性。若眼角膜輪部組織嚴重被破壞將阻礙眼角膜上皮和基質修復。成功治療關鍵於澈底刮除基質膠原纖維大分子的沉積物和水泥鈣化物。若眼角膜輪部組織嚴重被破壞則需要羊膜移植促進眼角膜上皮和基質修復。(長庚醫誌 2006;29:424-9)

關鍵字：水泥混合物，化學物灼傷，基質膠原纖維，羊膜移植。

長庚紀念醫院 台北院區 眼科部
受文日期：民國93年10月1日；接受刊載：民國94年3月31日
索取抽印本處：葉龍坤醫師，長庚紀念醫院 眼科部。桃園縣333龜山鄉復興街5號。Tel.: (03)3281200轉866; Fax: (03)3287798; E-mail: lkyeh@ms9.hinet.net