

## APPENDIX: SUMMARY OF RECOMMENDATIONS

### Code A (Prevention) recommendations

Before exposure to MG	<ul style="list-style-type: none"> <li>• Having protective equipment (standard mask, protective cloths)</li> <li>• Carry some potable water</li> <li>• Washing eyes constantly and quickly after exposure to MG</li> <li>• Civilian personnel should be evacuated from the area</li> </ul>
Immediately after exposure to MG	<ul style="list-style-type: none"> <li>• Washing eyes fast and consistently with water (potable water is preferred). Using shampoo is not recommended.</li> <li>• Using artificial tears and lubricant eye drops</li> <li>• Using antibiotic eye drops</li> <li>• Do not apply any eye pad</li> <li>• Take off all clothes</li> <li>• Bathing the whole body</li> <li>• Leaving the contaminated area quickly</li> </ul>
MG, mustard gas	

### Code B (Acute ocular injuries due to MG exposure) recommendations

Mild (Conjunctival involvement)	<p><b>Symptoms:</b> Tearing, foreign body sensation, photophobia, blepharospasm</p> <p><b>Signs:</b> Hyperemia of eyelids and conjunctival vasodilation and hyperemia, lack of corneal involvement</p> <p><b>Treatment:</b> Washing the eyes, using antibiotic eye drops, artificial tear and lubricant eye drops, topical corticosteroids and wearing sunglasses</p> <p><b>Follow-up:</b> A week after initial examination</p>
Moderate (Conjunctival and superficial corneal involvement)	<p><b>Symptoms:</b> Same as mild form in addition to eye pain and dry eye sensation</p> <p><b>Signs:</b> Those of mild form plus conjunctival edema, swelling of the corneal epithelium, superficial punctate keratopathy, superficial corneal aberrations</p> <p><b>Treatment:</b> Same as mild form plus the use of oral analgesics</p> <p><b>Follow-up:</b> Daily until corneal symptoms improve</p>
Severe (Conjunctival and deep corneal layers involvement)	<p><b>Symptoms:</b> Same as mild and moderate symptoms in addition to eyelid redness, swelling, scarring and eyelids spasms, loss of vision</p> <p><b>Signs:</b></p> <p>Same as mild and moderate plus any following signs:</p> <ul style="list-style-type: none"> <li>• Conjunctiva: secondary infection, ischemia, necrosis</li> <li>• Limbus: ischemia, necrosis</li> <li>• Cornea: stromal edema, secondary infection, perforation</li> <li>• Uvea: uveitis</li> </ul> <p><b>Treatment:</b> Treatment of moderate form plus:</p> <ul style="list-style-type: none"> <li>• Bandage contact lens (BCL) in case of large corneal epithelial defects without severe dryness or conjunctival and corneal infection</li> <li>• Oral doxycycline</li> </ul> <p>Conjunctivitis → culture → broad-spectrum antibiotics</p> <p>Corneal infection → culture → fortified broad-spectrum antibiotic eye drops</p> <p>Perforation of cornea less than 2 mm without iris prolapse → cyanoacrylate glue + BCL</p> <p>Perforation of cornea more than 2 mm with iris prolapse → corneal transplantation</p> <p><b>Follow-up:</b></p> <ul style="list-style-type: none"> <li>• Active corneal lesions: <ul style="list-style-type: none"> <li>• Hospital admission if possible</li> <li>• Daily visits</li> </ul> </li> <li>• Corneal perforation: <ul style="list-style-type: none"> <li>• The patient must be hospitalized</li> <li>• Daily visits</li> </ul> </li> </ul>
Diagnostic procedures for all three forms	<ul style="list-style-type: none"> <li>• Using MG detector if the existence of other gases is suspicious</li> <li>• Using clinical signs and symptoms to diagnose acute phase and severity of the injury</li> </ul> <p>Conclusion: Paraclinical and laboratory testing in the acute phase is not necessary</p>
MG, mustard gas	

**Code C (Chronic and delayed-onset ocular injuries due to MG exposure) recommendations**

Mild (Eyelid, conjunctival and superficial corneal involvement)	<p><b>Symptoms:</b> Foreign body sensation, dry eye, tearing, mild redness, photophobia, eye irritation</p> <p><b>Signs:</b></p> <ul style="list-style-type: none"> <li>• Eyelids: Meibomian gland dysfunction, blepharitis</li> <li>• Tears: Reduction of tear meniscus layer</li> <li>• Conjunctiva: Telangiectasia, vascular tortuosity mostly in the lid fissure, subconjunctival bleeding, fibrosis, scar</li> <li>• Cornea: Punctate epithelial erosions</li> </ul> <p><b>Treatment:</b></p> <ul style="list-style-type: none"> <li>• Using sunglasses</li> <li>• Living in wet climate</li> <li>• Artificial tear eye drops</li> <li>• Topical treatment of blepharitis (warm compress, scrub with shampoo, topical antibiotics). In patients who are resistant to topical antibiotics, oral antibiotics such as erythromycin or doxycycline can be prescribed.</li> <li>• Temporary punctal occlusion</li> </ul> <p><b>Follow-up:</b></p> <ul style="list-style-type: none"> <li>• Annual follow-up if symptoms are stable</li> <li>• In the event of any new complaint, ophthalmic examination is recommended in short intervals</li> </ul>
Moderate (Eyelid, conjunctival limbal and peripheral corneal involvement)	<p><b>Symptoms:</b> Same as mild form plus reduced vision, significant eye redness, itching and ocular pain</p> <p><b>Signs:</b> Signs of mild form plus:</p> <ul style="list-style-type: none"> <li>• Limbus: Mild to moderate ischemia, limbal stem cells deficiency</li> <li>• Cornea: Corneal epithelial irregularity, irregular corneal astigmatism, peripheral corneal thinning, peripheral corneal opacity, lipid and amyloid deposition, peripheral corneal neovascularization, peripheral corneal hemorrhage, decreased corneal sensation, transparency of the central cornea, periods of relapse and remission of symptoms</li> </ul> <p><b>Treatment:</b> Same as mild form in addition to:</p> <ul style="list-style-type: none"> <li>• Temporary or permanent punctal occlusion</li> <li>• Tarsorrhaphy</li> <li>• Prescribing corticosteroid eye drop or topical cyclosporine A (0.05%) twice daily</li> <li>• In the event of significant peripheral corneal thinning with symptoms such as redness, tearing and risk of corneal perforation, keratolimbal allograft should be performed</li> <li>• Do not perform conjunctival advancement surgery in presence of any peripheral corneal pathology</li> </ul> <p><b>Follow-up:</b></p> <ul style="list-style-type: none"> <li>• Follow-up every six months if symptoms are stable</li> <li>• If keratolimbal surgery is performed, a routine follow-up is enough for this type of surgery</li> <li>• Prescription or discontinuation of medications should be performed by the ophthalmic surgeon associated with nephrology and/or oncology consultation</li> <li>• In the event of any new complaint, short interval visits are recommended</li> </ul>
Severe (Eyelid, conjunctival, limbal and peripheral as well as central corneal involvement)	<p><b>Symptoms:</b> Same as mild and moderate forms plus severe vision loss, photophobia, intense pain</p>

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## Code C (Contd...)

**Signs:** Same as mild and moderate forms together with central corneal thinning, corneal opacity, corneal deposits, corneal neovascularization, corneal hemorrhage, band-shaped keratopathy, microbial ulcer, corneal melting, dermatocele, corneal perforation and conjunctivalization

**Treatment:** Same as mild and moderate forms plus:

Medical: Same as moderate form

Surgical:

- Tarsorrhaphy
- In case of persistent corneal epithelial defect: tarsorrhaphy and amniotic membrane transplantation
- In presence of corneal periphery, limbal and scleral thinning: keratolimbal allograft transplantation
- If limbal stem cell transplantation is required, keratolimbal method is preferred to using stem cells from first-degree relatives
- In case of corneal, limbal and adjacent scleral thinning and ischemia with corneal epithelial defect, combined limbal stem cells and amniotic membrane transplantation is recommended
- In case of central corneal opacity without endothelial involvement, lamellar keratoplasty is preferred to penetrating keratoplasty (PK)
- In case of central corneal opacity without endothelial involvement, standard lamellar keratoplasty is preferred to big-bubble technique
- If the limbal stem cell transplantation and lamellar keratoplasty technique are required, simultaneous surgery is preferred to sequential operation
- If PK and stem cells transplantation are needed, it is recommended to perform limbal stem cell transplantation ; PK should be performed several months later

**Follow-up:**

- Follow- up every 3 months in case of response to medical treatment and stabilization of symptoms
- In cases who have a history of ocular surgery, follow-up should be performed based on the routine follow- up related to the type of the surgery
- In the event of any new signs or symptoms, short interval visits are recommended

Diagnostic procedures for all three forms

**Light microscopy:** Chronic inflammation, reduction of goblet cells, corneal thinning, progression of the conjunctiva to the cornea

**Electron microscopy:** Destruction of the basement membrane of corneal cells, vacuolization of cytoplasm (non-specific)

**Fluorescent microscopy:** Non-specific findings

**Confocal microscopy:** Corneal thinning, corneal epithelial irregularity, reduction of stromal keratocytes, spindle shape keratocytes, non-specific deposits in the cornea

**Impression cytology:** Limbal cell deficiency; however the degree of deficiency do not match with the clinical signs

**Laboratory methods:** None of the laboratory tests are specific for mustard gas exposure

MG, mustard gas