

PART TWO

CONVENTIONAL MILITARY CHEMICAL INJURIES

CHAPTER 7

RIOT CONTROL AGENTS (IRRITANT AGENTS AND VOMITING AGENTS)

Section I. IRRITANT AGENTS

7-1. General

Irritant agents (lacrimators) are local irritants which in very low concentrations act primarily on the eyes, causing intense pain and lacrimation. Higher concentrations irritate the upper respiratory tract and the skin and sometimes cause nausea and vomiting. These agents may be dispersed as fine particulate smoke (aerosols) or in solutions as droplet aerosols. Examples of irritant agents are O-chlorobenzylidene malononitrile (CS), chloroacetophenone (CN), chloroacetophenone in chloroform (CNC), bromobenzylcyanide (CA), and dibenz-(b,f)-1,4-oxazepine (CR). They are used primarily in training and in riot control. Under certain conditions and with Presidential approval, they may also be used in combat. Some pulmonary irritants, such as CK and PS, are also lacrimators.

7-2. Protection

a. Protection against field concentrations of irritant agents is provided by the protective mask and ordinary field clothing secured at the neck, wrists, and ankles. The protective hood may also be worn with the mask. Individuals who handle CS should wear rubber gloves, protective mask with hood, rubber boots, and rubber apron. The BDU should be secured at the neck, wrists, and ankles.

b. Following exposure, clothing and individual equipment should be inspected for agent residue. If a residue is found, individuals should change or decontaminate the clothing to protect themselves and other unmasked persons. Decontaminate CS-contaminated clothing by airing for a few minutes.

7-3. Properties

a. Agent CS. Agent CS is a white crystalline solid which melts at 194 °F (90 °C) and is stable under ordinary storage conditions. It has a pungent, pepper-like odor. A CS cloud is white at the point of release and for several seconds after release. Agent CS is disseminated by burning, exploding, and forming an aerosol. It may also be used in liquid form in an

appropriate solvent. This agent is faster-acting, about 10 times more potent, and less toxic than CN.

b. Agent CR. Agent CR is a pale yellow crystalline solid which melts at 163 °F (73 °C) and is stable in organic solutions. It has limited volatility in water and is not hydrolyzed in aqueous solutions. It has a pepper-like odor. The agent is currently used only in solution for dissemination in liquid dispensers. The solution in the dispensers contains 0.1 percent CR in 80 parts propylene glycol and 20 parts water. In organic solutions, CR is an eye irritant at concentrations of 0.0025 percent or even lower. Agent CR differs from CS in being less toxic when inhaled but skin effects are more pronounced and longer lasting. It is more persistent in the environment and on clothing.

c. Agents CN and CA. Agent CN is a white crystalline solid, boiling at 478 °F (248 °C) and freezing at 129°F (54°C). Agent CA is usually a liquid, boiling at 468°F (242°C) and freezing at 77°F (25°C). Agent CN may also be used in liquid form in appropriate solvents. The odor of CN is like that of apple blossoms. The odor of CA is like that of sour fruit. These agents may appear as a bluish-white cloud at the point of release. A solid agent is dispersed as fine particulate smoke and as vapor from burning munitions, such as lacrimator candles and grenades. Liquid agents may be dispersed from airplane spray or bursting munitions.

7-4. Effects

a. Agent CS.

(1) *Eyes and respiratory tract.* When an unmasked person enters a cloud of CS, the effects are felt almost immediately. Incapacitation begins in 20 to 60 seconds, depending upon the degree of agent concentration. The effects last for 5 to 10 minutes after removal to fresh air. There is marked burning pain in the eyes with copious lacrimation and blepharospasm, thin mucous nasal discharge, coughing, and dyspnea. Following heavy exposures, there may be nausea and vomiting. Exposure to

extremely high concentrations in an enclosed space may cause tracheitis and bronchitis. Even if that happens, permanent damage is very unlikely.

(2) *Skin.*

(a) Warm, moist skin (especially on the face, neck, ears, and body folds) is susceptible to irritation by CS. A stinging sensation may occur promptly, even at moderately low concentrations. Higher concentrations may cause an irritant dermatitis with erythema and, rarely, blisters on the same body regions. Stinging subsides after 5 to 10 minutes, even with continued exposure. An increase in the stinging is noted upon the individual's removal to fresh air. Repeated exposures may cause delayed hypersensitivity with allergic contact dermatitis. Individuals engaged in bulk handling and exposed to large quantities of CS report stinging sensations in warm, moist skin areas. Inflammation and blistering similar to sunburn may occur after a heavy or prolonged exposure, especially if the individual's skin is fair. Figures 7-1 and 7-2 show burns caused by exposure to CS.

(b) The following solution can be applied as a wash or spray to cleanse unbroken skin of CS handlers. (If this is painful in the eyes or in

wounds, normal saline should be used instead.) To make the solution, add 100 gm of sodium bicarbonate, 50 gm of sodium carbonate, and 15 ml of 10 percent benzalkonium chloride solution to 1,500 ml of distilled water. The solution is stable and should be prepared in advance of need. The solution may be issued to CS handlers, as required, without a prescription.

b. *Agent CR.* Agent CR is similar in effect to CS, but the minimal effective concentration is lower and the lethal concentration (LCt) is higher. Symptoms and treatment are similar to those of CS.

c. *Agents CN and CA.*

(1) *Eyes and respiratory tract.* The vapors or smokes of these agents cause basically the same reactions as does CS. However, their toxicities are generally higher and their effectiveness as lacrimators are generally lower than CS; that is, higher concentrations of CN or CA are required to produce an irritant effect equivalent to that of CS. Recovery is quick if exposure is brief, but prolonged exposure may cause conjunctivitis and photophobia. Extremely high concentrations of these agents in enclosed spaces may cause tracheitis, bronchitis, pulmonary edema, or cerebral edema. Exposures of this magnitude are rare.

[Click here for Figure 7-1.](#)

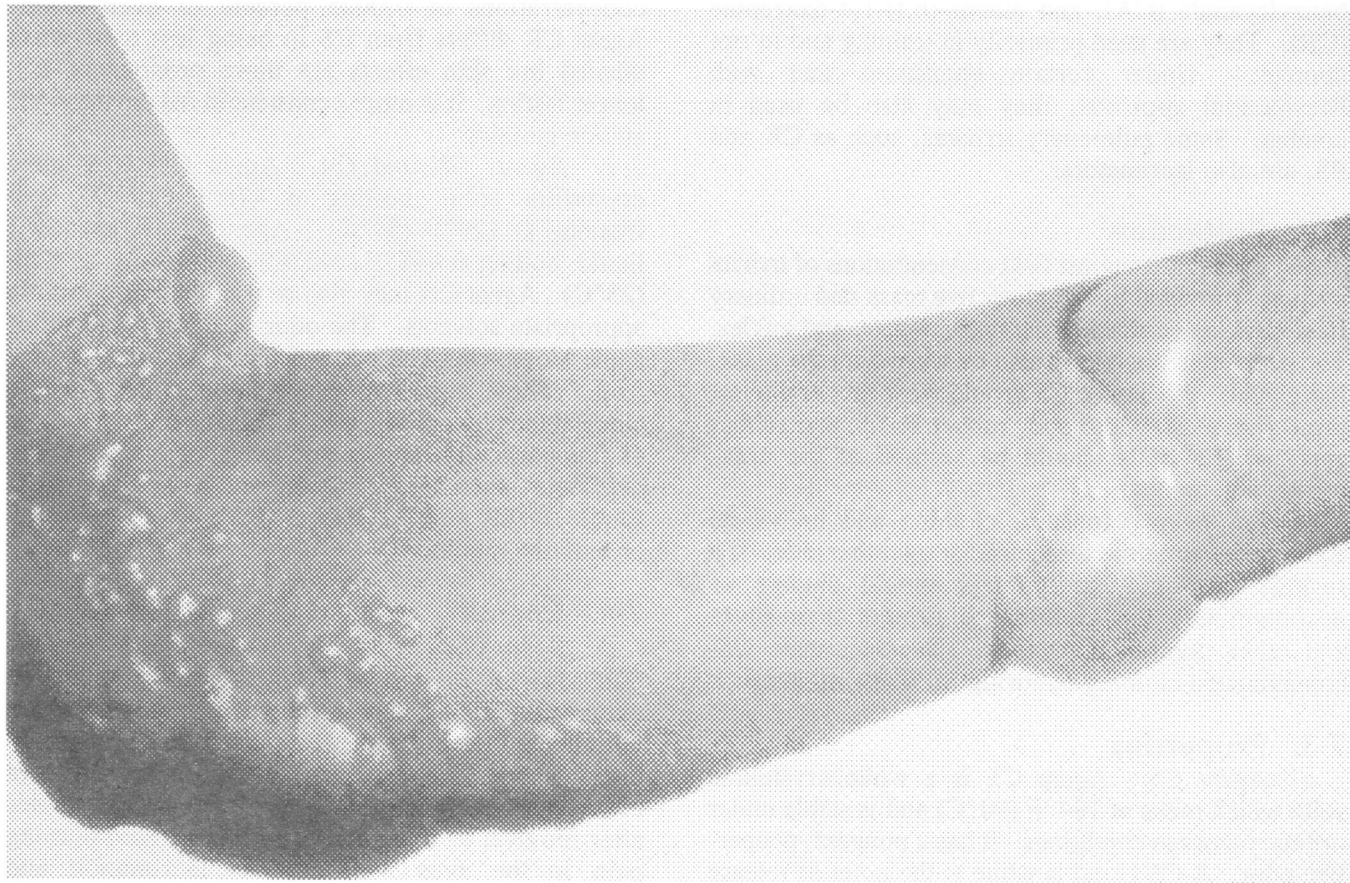


Figure 7-1. Skin burn caused by exposure to CS.

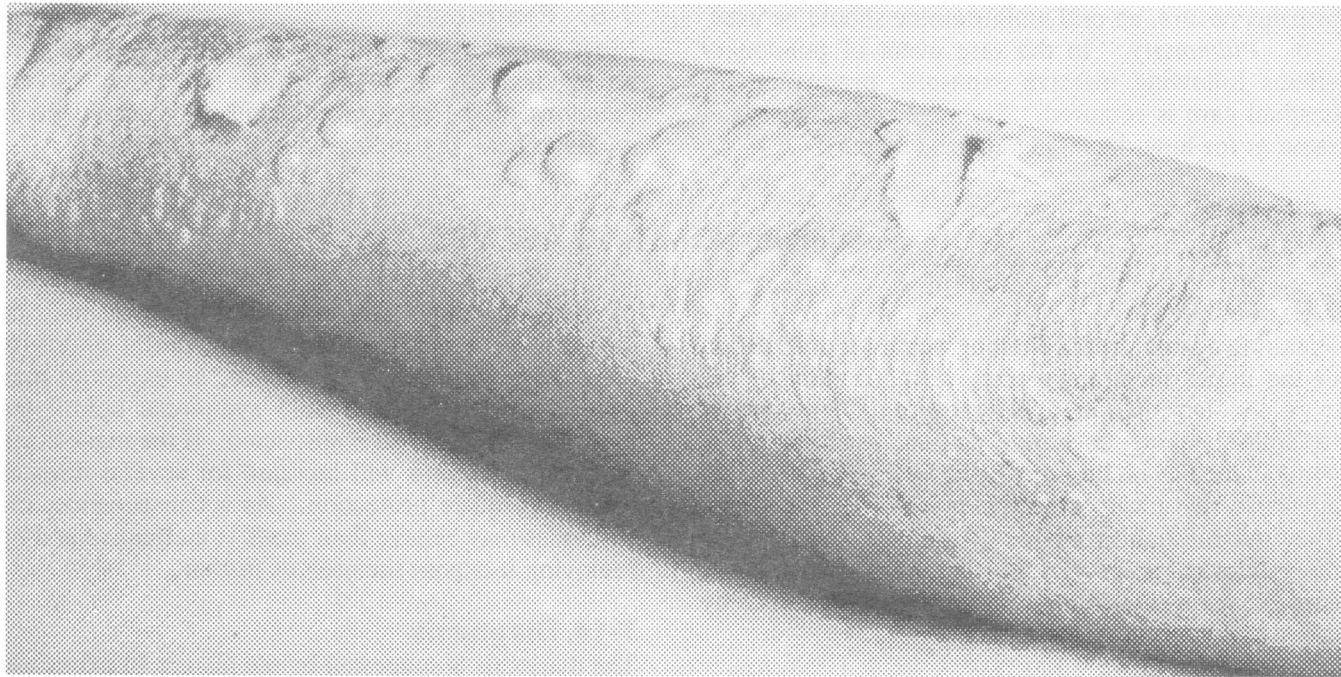


Figure 7-2. Burn caused by CS, showing desquamation of skin.

[Click here for Figure 7-2.](#)

(2) *Skin*. Stinging of the skin and, with higher concentrations, irritant dermatitis may occur in warm, humid weather. These agents are potential skin sensitizers although apparently less so than CS. Droplets of liquid or particles of solid lacrimators in the eyes may be corrosive and produce burns like those of a strong acid.

7-5. Diagnosis

a. Agent CS. Diagnosis of exposure to CS is made from the pepper-like odor, the presence of intense eye effects, dyspnea, coughing, and mucous rhinorrhea.

b. Agent CR. Diagnosis of exposure to CR is similar to the diagnosis of CS. CR produces a burning sensation in the nose and sinuses.

c. Agents CN and CA. Diagnosis of exposure to these agents is made from their odors and from the marked coughing and dyspnea, in addition to the eye effects in paragraph 7-4 *a* (1) above. Also, headache and mental depression may appear as late effects of CN exposure.

7-6. Self-Aid

Put on the protective mask, clear it, and keep your eyes open as much as possible. Move out of the contaminated environment, if possible. When your vision clears, go on with your duties. When it is safe to do so, remove the mask and blot away the tears. **DO NOT** rub the eyes. If drops or particles have entered the eye, try to forcibly open it and flush it with copious amounts of water. Chest discomfort usually can be relieved merely by talking. If exposure has been heavy, significant cutaneous reaction may

develop. The cutaneous reaction can be prevented by immediately flushing the skin with copious amounts of water.

7-7. Treatment

a. Eyes. Ordinarily, the effects on the eyes are self-limiting and do not require treatment. If large particles or droplets of the agent are in the eye, treatment as for corrosive materials may be required. This is much less likely in CS exposure than in CA or CN exposure. Prompt irrigation of the eye with copious amounts of water is essential. Impacted particles of the agent may be removed mechanically. After complete decontamination, an ophthalmic corticosteroid ointment maybe used. Patients heavily exposed to CN or CA must be observed closely for development of corneal opacity and iritis. If either condition develops, promptly evacuate the patient for definitive ophthalmologic treatment.

b. Skin. Ordinarily, early (up to 1 hour) erythema and stinging sensation are transient and do not require treatment. Delayed erythema (irritant dermatitis) may be treated with a bland shake lotion (such as calamine lotion) or a topical corticosteroid (0.10 percent triamcinolone acetonide, 0.025 percent fluocinolone acetonide, 0.05 percent flurandrenolone), depending upon severity. Cases with blisters should be managed as a second degree burn. Treat oozing acute contact dermatitis with a wet dressing of 1 to 40 Burow's solution or colloidal oatmeal for 30 minutes, three times daily. The topical steroid should follow the wet dressing immediately. Secondary infections are treated with appropriate antibiotics. If significant

pruritus occurs, an oral antihistamine should be used.

c. Pulmonary. In the rare event of pulmonary effects following massive exposure, evacuation for hospital care is required. Treatment is basically the same as for lung-damaging agents (chap 5).

7-8. Prognosis

Most persons affected by irritant agents require no medical attention. Casualties are rare. Severe reactions of the eyes or the skin may take days or weeks to heal, depending upon their severity.

Section II. VOMITING AGENTS

7-9. General

Vomiting agents produce strong pepper-like irritation in the upper respiratory tract with irritation of the eyes and lacrimation. They cause violent uncontrollable sneezing, coughing, nausea, vomiting, and a general feeling of bodily discomfort. The principal agents in this group are diphenylchloroarsine (DA), diphenylaminochloroarsine (Adamsite (DM)), and diphenylcyanoarsine (DC). They are dispersed as aerosols and produce their effects by inhalation or by direct action on the eyes.

7-10. Protection

The protective mask gives adequate protection against field concentrations of vomiting agents. No protective clothing is required.

7-11. Properties

All three agents (DA, DC, and DM) are crystalline solids which are usually dispersed by heat as fine particulate smokes. When concentrated, DM smoke is canary yellow; DA and DC smokes are white. All are colorless when diluted with air. Low concentrations of these agents are effective and may not be detectable at the time of exposure.

7-12. Pathology

Vomiting agents produce local inflammation of the upper respiratory tract, the nasal accessory sinuses, and the eyes.

7-13. Symptoms

Vomiting agents produce a feeling of pain and a sense of fullness in the nose and sinuses, accompanied by a severe headache, intense burning in the throat, and tightness and pain in the chest. Irritation of the eyes and lacrimation are produced. Coughing is uncontrollable and sneezing is violent and persistent. Nasal secretion is greatly increased and quantities of ropy saliva flow from the mouth. Nausea and vomiting are prominent. Mental depression may occur during the progression of symptoms. Mild symptoms, caused by exposure to very low concentrations, resemble those

of a severe cold. The onset of symptoms may be delayed for several minutes after initial exposure (especially with DM). Therefore, an exposure may occur that can produce mild symptoms before the presence of the smoke is suspected. If the mask is put on then, symptoms will increase for several minutes despite adequate protection. As a consequence, the casualties may believe their mask is ineffective and by removing it expose themselves further.

7-14. Diagnosis

The diagnosis is suggested by the history of exposure, the concurrence of respiratory and eye irritation with nausea, and the relatively rapid spontaneous improvement which occurs despite the original miserable appearance and condition of the patient.

7-15. Self-Aid

Put on the protective mask and wear it in spite of coughing, sneezing, salivation, and nausea. If necessary, lift the mask from the face briefly to permit vomiting or to drain saliva from the facepiece. Replace, clear, and recheck your mask. Carry on with your duties as vigorously as possible—this will help lessen and shorten the symptoms. Combat duties usually can be performed despite the effects of vomiting agents.

7-16. Treatment

Few cases should reach the MTF because recovery is usually prompt. Symptomatic relief may be obtained by using a current antiemetic such as trimethopbenzamide hydrochloride (Tigan™) which can be given IM, IV, orally, or rectally. Aspirin may be given to relieve headaches and general discomfort.

7-17. Prognosis

Symptoms of exposure to field concentrations of vomiting agents usually disappear in 20 minutes to 2 hours, leaving no residual injury. However, a few instances of severe pulmonary injury and death have occurred due to accidental exposures to high concentrations in confined spaces.