

Tear Gas

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We have heard the name of tear gas a lot in recent months. However, what is tear gas? Do you know the principle of tear gas?

In this issue of Sound of Science, we are going to talk about

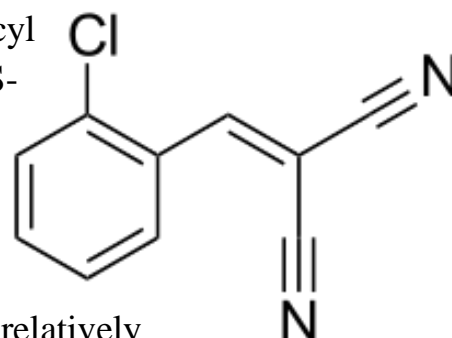
- the chemical constitutions in Tear gas
- the effect of it
- the risk of it
- the treatment



What is Tear gas?

Tear gas, formally known as a **lachrymatory agent** or lachrymator(催淚劑) (in Latin lacrima means "tear"), sometimes colloquially known as mace, is a chemical weapon that causes severe eye and respiratory pain, skin irritation, bleeding, and even blindness. In the eye, it stimulates the nerves of the lacrimal

gland(淚腺) to produce tears. Common lachrymators include pepper spray (OC gas), PAVA spray (nonivamide), CS gas, CR gas, CN gas (phenacyl chloride), bromoacetone, xylyl bromide, syn-propanethial-S-oxide (from onions), and Mace (a branded mixture), and household vinegar.



Lachrymatory agents are commonly used for riot control. The chemical weapon is used against civilian population during relatively peaceful times, but not against enemy soldiers during war times, the act being prohibited by various international treaties. During World War I, increasingly toxic and deadly lachrymatory agents were used.

Effect

Tear "gas" generally consists of **aerosolized solid or liquid compounds** (霧化固體或液體化合物) (bromoacetone or xylyl bromide), not gas. Tear gas works by irritating mucous membranes in the eyes, nose, mouth and lungs, and causes crying, sneezing, coughing, difficulty breathing, pain in the eyes, and temporary blindness.

With CS gas, symptoms of irritation typically appear after 20–60 seconds of exposure and commonly resolve within 30 minutes of leaving (or being removed from) the area. With pepper spray (also called "oleoresin capsicum", capsaicinoid or OC gas), the onset of symptoms, including loss of motor control, is almost immediate. There can be considerable variation in tolerance and response, according to the National Research Council (US) Committee on Toxicology.

The California Poison Control System analyzed 3,671 reports of pepper spray injuries between 2002 and 2011. Severe symptoms requiring medical evaluation were found in 6.8% of people, with the most severe injuries to the eyes (54%), respiratory system (32%) and skin (18%). The most severe injuries occurred in law enforcement training, intentionally incapacitating people, and law enforcement (whether of individuals or crowd control).



Risk

As with all non-lethal(非致命), or less-lethal weapons, there is some risk of serious permanent injury or death when tear gas is used. This includes risks from being hit by tear gas cartridges, which include severe bruising, loss of eyesight, skull fracture, and even death. A case of serious vascular injury from **tear gas shells** has also been reported from Iran, with high rates of associated nerve injury (44%) and amputation (17%), as well as instances of head injuries in young people.

While the medical consequences of the **gases** themselves are typically limited to minor skin inflammation(皮膚炎症), delayed complications are also possible: people with pre-existing respiratory conditions such as asthma, who are particularly at risk, are likely to need medical attention and may sometimes require hospitalization or even ventilation support. Skin exposure to CS may cause chemical burns or induce allergic contact dermatitis. When people are hit at close range or are severely exposed, eye injuries involving scarring of the cornea(角膜癍痕) can lead to a permanent loss in visual acuity. Frequent or high levels of exposure carry increased risks of respiratory illness.

Reports of **expired tear gas**(過期催淚瓦斯) canister picked up by protesters in Egypt led to theories that it could be more toxic, but Steve Wright of Leeds Metropolitan University said if enough time has elapsed that the chemicals have broken down inside the can, then it makes the canister less effective. However, a study carried out by Mónica Kräuter, a Venezuelan professor of Simón Bolívar University, collected thousands of tear gas canisters fired by Venezuelan authorities in 2014, showed that 72% of the tear gas used was expired and noted that expired tear gas "breaks down into cyanide oxide, phosgenes and nitrogens that are extremely dangerous".

Treatment

There is **no specific antidote** (沒有具體的解毒劑) to common tear gases. Getting clear of gas and into fresh air is the first line of action. Removing contaminated clothing and avoiding shared use of contaminated towels could help reduce skin reactions. Immediate removal of contact lenses has also been recommended, as they can retain particles.



Once a person has been exposed, there are a variety of methods to remove as much chemical possible and relieve symptoms. The standard first aid for burning solutions in the eye is irrigation (spraying or flushing out (噴灑或沖洗) with water. There are reports that water may increase pain from CS gas, but the balance of limited evidence currently suggests water or saline are the best options. Some evidence suggests that Diphoterine solution, a first aid product for chemical splashes, may help with ocular burns or chemicals in the eye.

Bathing and washing the body vigorously with soap and water can remove particles that adhered to the skin while clothes, shoes and accessories that have come into contact with vapors must be washed well since all untreated particles can remain active for up to a week. Some advocate using fans or hair dryers to evaporate the spray, but this has not been shown to be better than washing out the eyes and it may spread contamination.

Anticholinergics (抗膽鹼能藥物) can work like some Antihistamines as they reduce lacrymation and decrease salivation, acting as an antisialagogue, and for overall nose discomfort as they are used to treat allergic reactions in the nose (e.g., itching, runny nose, and sneezing)

Oral analgesics (口服鎮痛藥) may help relieve eye pain.

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COMIC CORNER



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