TEAR GASES AND HEALTH

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ABSTRACT

Use of tear gases to control civil unrest is accepted practice by government authorities worldwide, in spite of their harmful effects in human health and its ban by different organization. The most commonly used riot control agents used as fumigant includes pepper spray, popularly known as OC (Oleoresin Capsicum) and different types of tear gases which are o-chlorobenzylidene malononitrile, known commonly as CS, omega-chloroacetophenone, known as CN, and dibenz 1,4-oxazepine, known as CR and different types of solvent used to disperse these agents. These gases are responsible for not only the acute and chronic health effects but also for the significant economic loss. Investigations shows that CS, CN, OC, CR and methylene chloride (the solvent used to disperse these agents) are responsible for acute and chronic health effects ranging from severe flu-like symptoms, to pulmonary edema and acute respiratory distress, to chromosome aneuploidy in germ and somatic cells, which may leads to birth defects in offspring and cancer. The only immediate physical symptoms developed by a victim of these gases are the irritating and immediately debilitating effects of the CN or CS itself. Apparently, the immediate acute effects of the gas wear off within ten to fifteen minutes. Although the chemical agents have been used for many years, full extent of effects on health is far beyond our understanding. All manufacturers and the police department must disclose the material data safety sheets of all chemicals used in crowd control and strictly follow the guidelines for deployment. Manufacturers should be responsible for the acute and chronic health effects of the chemicals they create and government should take responsibility for after care.

Key Words: Tear gases, Health hazards, Nepal.

INTRODUCTION

Tear gases have been being used as an accepted practice when faced with combative suspects, for riot and demonstration control, and for alleviating hostage and siege situations, in spite of their harmful effects in human health and its ban by different organization. Proponents of their use claim that, if used correctly, the noxious effects of exposure are transient and of no long-term consequences. Although, the use of these irritant incapacitants is reasonable in certain circumstances such as hostage and siege situations because of elimination of the need for lethal force, its use in a mass of people certainly has significant impact on the health and economy. Recently we became observers of the police agitation against the civil disobedience demanding the restoration of the constitution 1990. The police force had used tear gases to suppress the demonstration. Amazing was the situation that the so-called human right activist and media were silent regarding the use of harmful chemical agents. Even the media had rejected to publish submitted articles on tear gases and their effects on health. The chance of police aggression with chemical agents against people is still present and it is relevant to review the

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effects of tear gases on human health. The use of chemical warfare against citizens in the name of controlling the demonstration without giving prior notification of the agents used in riot control is highly condemned by different medical communities. While tear gas and pepper spray are banned from use in war by an international treaty, domestic use is legal and nearly ubiquitous in the most of the countries.

TEAR GASES

Various kinds of lacrimators and tear gases, which are being used in chemical warfare, are accepted as riot control agents. The most commonly used riot control agents used as fumigant includes pepper spray, popularly known as OC (Oleoresin Capsicum) and different types of tear gases which are o-chlorobenzylidene malononitrile, known commonly as CS, and omega- chloroacetopheonone, known as CN, and dibenz 1,4-oxazepine, known as CR. At normal daily temperatures and pressure these agents form solid white crystals and when used for riot control they are dispersed as microparticulate clouds or spray by pyrotechnic devices by mixing with propellants and nonaqueous solvents such as the industrial degreaser methyl isobutyl ketone and methylene chloride.[1]

Pepper spray, the most recent chemical agents widely used in the personal defense and riot controlling situations, is the least toxic agents used among all because of its transient effects on health. It is commonly known as OC and was introduced in 1976 as a 'less lethal' substitute to other tear gases. It has been used as a disabling weapon in hostile encounters with citizens since 1987.[3] In 1996, the State Legislature requested the New York State Department of Health to formulate the regulations regarding the types of self-defense spray devices which could legally be purchased, possessed, and used in New York State. Based on the review of the available information, the Department of Health concluded that oleoresin capsicum posed a lower public health concern than o-chlorobenzylidene malononitrile or omega-chloroacetophenone, and developed a rule that specifies oleoresin capsicum as the only active ingredient to be used in self-defense sprays for sale and use in New York State.[4] Since then many individuals are turning to personal aerosol protection devices (PPADs) for self protection in western community.[5] The resin of the Capsicum, the cayenne pepper plant, is extracted and mixed with a liquid solvent, such as methylene chloride, in order to be dispersed as a spray. The recommended use of OC is a single short burst targeted to the eyes from several feet away, causing acute irritation and temporary loss of muscle control. But this is not the rule during riot control and many people might be sprayed continuously at short range by polices. OC came under criticism in Los Angeles in 1993 when it was evaluated as the cause of several deaths of suspects in custody who were not treated after being exposed.[3] The inhalation of OC can be disastrous for people suffering from bronchial asthma or heart problems. The indiscriminate use of pepper spray against large groups of people increases the probability that someone in the crowd will die as a result of exposure.[6]

CS, CR and CN, the common forms of tear gases, excessively used as irritant incapacitants, are actually not gases at all. CN is a liquid and CS and CR are solid and they form white crystal in normal temperature and pressure. [7] CN was first produced by the European manufacturer Graebe in 1871. It was first developed for the use in war and riots by military and police. In 1928, American company Corson and Stoughton had introduced CS as an alternative to CN. It is more chemically stable and up to ten times more potent but less systemically toxic and had subsequently replaced CN in virtually all war and riot control activities.[2]

Most of these gases, though banned, are produced in North America and different modes of dispersing are developed. The US army developed many different ways of deploying CS, from sprays to exploding grenades during the Vietnam conflict. In 1969, eighty countries voted to include tear gas as among the agents banned for use in war under the Geneva Protocol. Most of the countries including the USA were among the signing countries; however the substances were not banned for use domestically.[8] There are currently 108 manufacturers of CS and CN products in North America alone [9] and this accounts for 41% of all the CS and CN manufactured in the world. In order for either to be dispersed as a gas or as a fumigating agent, they must be mixed with a solvent agent that creates a gassy form that can be released from canisters. Conventionally the solvent is supposed to be inert and has no singular effects on the target of the gas.

HEALTH HAZARDS

These gases are responsible for not only the acute and chronic health effects but also for the significant economic loss. OC, CS, CR and CN commonly cause only few symptoms when they come in contact with mucus layer and main purpose is to create an extreme fear. The only immediate physical symptoms developed by a victim of these gases are the irritating and immediately debilitating effects of the OC, CN, CR or CS itself. Investigations shows that CS, CN, OC, CR and solvents such as methyl isobutyl ketone and methylene chloride are responsible for acute and chronic health effects ranging from severe flu-like symptoms, to pulmonary edema and acute respiratory distress, to chromosome aneuploidy in germ and somatic cells, which may leads to birth defects in offspring and cancer. CN, OC, CS and CR cause almost instant pain in the eyes, a burning sensation, epiphora (excessive flow of tears),

blepharospasm (closure of the eyelids), visual problems, and incapacitation of exposed individuals. Most of these symptoms are limited to acute conjunctivitis causing the target to inadvertently close his or her eyes and irritation of the throat and nasal cavity. Both of these effects trigger acute fear in the victim. The person will either lose voluntary control of their muscles or fall to the ground or run blindly away from the gas. Apparently, the immediate acute effects of the gas wear off within ten to thirty minutes.

Apart from the effects on the eyes, these agents also cause irritation in the nose and mouth, throat and airways and sometimes to the skin, particularly in moist and warm areas. In situations of massive exposure, tear gas, which is swallowed, may cause vomiting. [2] Underlying morbidity in exposed people such as asthma, chronic obstructive airway disease, hypertension, and cardiovascular disease makes the appearance of these features more prominent and severe leading even to death. The irresponsible dispersal of tear gas in crowded streets causes a lot of people, irrespective of whether or not they are protesting, to fall ill. Along with the ill health people lose working hours, which comes at a nearly incalculable price for employers and government. Even more important is the fact that we will not know the full extent of the health effects of these gasses for many years, when young people who were exposed begin having children with birth defects or develop tumors in their organs.

O-chlorobenzylidene malononitrile (CS) is a solid and it is used as a gas or aerosol after dissolving in methylene chloride or other solvents. It is by no means a harmless tear gas, as often is described; in particular, CS is a very effective irritating war gas. It is available in 1 % and 5 % strength for riot control purposes. The effects of CS on humans are relatively unknown because publications in this respect are mostly on military medical research, partly classified as secret, and brought to the knowledge of a small number of experts only. CS is highly soluble in water, and hence the effects in police water jets are very low. The efficacy of CS-containing water jetting consists only in the pressure of the jet stream. Medically, in police use, CS is therefore considered to be harmless. Military medical research results, however, show that persons older than 30 years, those under physical strain, and those with hitherto undetected aneurysm are especially at risk. Based on the available toxicological and medical evidence, CS and CR have a large safety margin for life-threatening or irreversible toxic effects. There is no evidence that a healthy individual will experience long-term health effects from open-air exposures to CS or CR if guidelines of their deployment followed properly, although contamination with CR is less easy to remove. But in the heat of crisis and aggression the polices may overact by excessive use of these agents, or the combatants may not leave the area and thus remain exposed and away from the gas's natural antidote – the fresh air and such behavior definitely leads to disater.

Omega-chloracetophenone (CN) is widely used as tear gas by police and civilians for self-defence. It may affect the eyes, respiratory system and skin, sometimes causing serious injuries. Both irritative and allergic contact dermatitis have been described. [10] CN is the most toxic lacrimator and at high concentrations has caused corneal epithelial damage and chemosis. Serious systemic toxicity is rare and occurs most frequently with CN; it is most likely to occur when these agents are used in very high concentrations within confined non-ventilated spaces It has accounted for at least five deaths, which have resulted from pulmonary injury and/or asphyxia.[2]

Methylene chloride, the commonly used solvent to disperse these tear gases, is said to be an inert gas although many studies shows it could be harmful agent. Usually, it is a solvent used in paint thinners and varnish stripping agents. Nevertheless it has been classified as a probable human carcinogen and several dozen medical studies has documented it as a cause of liver and kidney damage, lung tumors, cell mutations, birth defects and other life-threatening effects.[11] In addition, Methylene chloride also causes central nervous system depression, fatigue, muscle aches, confusion, and headaches.[12,13] Acute exposure leads to hundreds of people missing work for days after they return home and found themselves suffering from flu like symptoms. It is difficult to calculate precisely the loss of productivity and merchandise. Another solvent used is the industrial degreaser methyl isobutyl ketone. Exposure to such solvents can by itself cause dermal scaling, peeling and blistering as well as irritation of the eyes and respiratory tract.[14]

In addition to the above-mentioned gases, combined use of these gases at the same time is not uncommon and the real extent of the effects caused by such action is beyond our understanding. In actual situation, different chemicals can be used on crowds, spraying them with pepper spray and canisters of tear gases. There has been very little research conducted on the synergistic effects of chemicals, which may be extremely toxic when released in conjunction with one another.

LITERATURE REVIEW

Only limited data is available regarding the epidemiological studies of tear gas exposure. Some insight can be gleaned from data collated by the National Poison Information Service in England. In 1997, it received 597 enquiries from physicians seeking advice about the management of patients who had been exposed to crowd-control agents.[15] Most enquiries

concerned ocular (irritation, lacrimation, corneal abrasions), dermal (rash, erythematous dermatitis, blisters, bullae, eczema, edema), respiratory (coughing, dyspnea), neurologic (headache, drowsiness), cardiac (tachypnea, hypotension, chest pain) and gastrointestinal (buccal irritation, vomiting) symptoms. Fifty-four people with dermal symptoms who presented within 6 hours after exposure had erythema and irritation, whereas 203 people with these symptoms who sought treatment 6 hours or more after exposure had blisters, bullae, eczema and edema. This difference suggests that there may be delayed adverse dermal effects to teargas exposure.

In another study reported from Hon Kong during a riot at a Vietnamese detention center based on the presentation of 184 patients with symptoms consistent with CS exposure to the British Red Cross Clinic after the incident showed that the most common complaints were burns (52%), cough (38%), headache (29%), shortness of breath (21%), chest pain (19%), sore throat (15%) and fever (13%). However, the only common findings on examination by a physician were burns (52%) and an inflamed throat (27%).[16] All burns could be categorized as "minor' according to the American Burns Association classification and all were consistent with CS gas exposure.

Table I : Symptoms Described by 55 Victims of Tear Gas and Pepper Spray in the Seattle WTO Protests.[17]

Symptoms	Described Number of Victims (Percentage)
EYES / NOSE / THROAT / EARS / SKIN	
Sore throat	15 (27)
Redness in Eyes	9 (16)
Nose Congestion	9 (16)
Swollen Sinuses	9 (16)
Skin Irritation	8 (14)
Temporary Blindness	7 (12)
Nose irritation	7 (12)
Tearing	6 (10)
Voice Lost	6 (10)
Nose Bleed	3 (5)
Earache	2 (3)
Lumps on tongue	2 (3)
Swollen glands	1 (1)
GASTRO-INTESTINAL	
Nausea	7 (12)
Diarrhea	7 (12)
Cramps	4 (7)
Vomiting	3 (5)
COGNITIVE DISTURBANCE	
Difficulty focusing	11 (20)
Dizziness	9 (16)
Disorientation	9 (16)
Coordination problems	4 (7)
Difficulty finding words	4 (7)
Hallucinations	3 (5)
Nervousness	1 (1)
Numbness in limbs	1 (1)
RESPIRATORY SYSTEM	
Coughing	13 (23)
Chest constriction	11 (20)
Coughed-up phlegm	9 (16)
Breathing difficulty	7 (12)
Asthma	2 (3)
MISCELLANEOUS	
Fatigue	14 (25)
Body aches	13 (23)
Fever	9 (16)
Headache	8 (14)
Emotional distress	7 (12)
Difficulty regulating body temp.	7 (12)
Hot/Cold flashes	6 (10)
Restless sleep	1 (1)
Menstrual irregularity (of 26 women)	9 (34)

This study has recorded few newer symptoms, which were previously not known like haemoptysis (8%) and haematemesis (4%), but these were only confirmed in one patient. The majority of patients had recovered within 2 weeks of exposure although one asthmatic patient complained of shortness of breath lasting for 33 days and a sore throat lasting for 38 days after the incident. She had abnormally low peak expiratory flow readings, but had a clinical history of asthma. No serious sequelae were encountered, but the incidence of burns in these patients was higher than expected from a review of the literature.

Another report published by "Physicians for Social Responsibility—Los Angeles" in 2001 regarding the Seatle incident also showed similar findings.[17]

Although the chemical agents have been used for many years, full extent of effects on health is far beyond our understanding. The more one understands about methylene chloride, CS, CN, CR, OC, and other irritants and their 'inert ingredients,' the more one realizes that these costs, monetary loss and more importantly health hazards may be felt long into the future.

Therefore, such irresponsible and unnecessary deployment of these agents is a threat to mankind and immediate action against such behavior should be taken timely. The use of these gases as per the safety sheet provided by manufacturers is not always the rule in real scenario. Even with strict guidelines regarding chemical weapons, it is nearly impossible for police officers to monitor their use during an actual deployment. As happened in the streets of Kathmandu, clouds of tear gas affected protestors and bystanders alike and even to the hospitalized patients when few canisters were exploded in hospital premise. The tear gases were used on healthy and ill individuals - advised against by most manufacturers. Neither the police nor the government hospitals take any responsibility for aftercare of the exposed people. Even there was no any information regarding the types of gases used. There was a great potential for overexposure, especially among people who were close to exploding canisters who were unable to escape quickly.

Furthermore, strict follow up of guidelines provided in data safety sheet is a key in minimizing the health hazards, even though the importance of ban on the use of these gases against civilians could not be underestimated. All manufacturers and the police department must disclose the material data safety sheets of all chemicals used in crowd control. Manufacturers should be responsible for the acute and chronic health effects of the chemicals they create. The police officers and security forces must be educated about the risks of the chemicals they disperse and be held responsible for the aftercare of those they expose. There is an ongoing need for investigation into the full toxicological potential of tear gas chemicals and renewed debate on whether their use can be condoned under any circumstances. Therefore, there should be a domestic ban on the use of supposed 'non-lethal' weapons till further supporting data available as they are banned by the Chemical Weapons Convention for use in international warfare.

More over, there are also better ways to serve and protect the public than to disperse inadequately tested, unregulated chemical weapons. Unless there is independent research establishing that these weapons are reasonably safe, and until there is credible oversight of the police practices and manufacturers' claims, the public has no way to assess how much risk it is accepting in the name of law and order.

So, the use of CS gas and other tear gases with comparable clinical effects should be taken as tantamount to chemical warfare against civilians and, therefore, the use of these agents against human populations everywhere should be banned.

TREATMENT AND PREVENTION

It is recommended to have an arrangement for aftercare when such situations are expected. Contaminated clothes of exposed people should be removed to prevent secondary contamination; medical staff should wear gloves and goggles when providing treatment. Washing with soap and water is not necessary unless symptoms persist, because the most of tear gases can dissolve in water and further exacerbate symptoms or contaminate other surfaces. Hot water should be avoided because it may cause any residual particles to vaporize and give rise to secondary contamination.[18] Recommendations for treating eyes contaminated with CS vary. Some clinician suggest blowing dry air with a fan over the eyes to vaporize the CS particles; the area downwind of the fan should be vacant to avoid secondary contamination. Others recommend irrigation with normal saline. Persistent ocular irritation is usually the result of a particle of CS embedded in the surface, so a thorough slit-lamp examination should be conducted.

Although current evidence suggests that tear-gas, especially CS exposure is not dangerous to most people.[19] Exposure may trigger laryngospasm or bronchospasm in people with pre-existing respiratory disease, such as asthma or bronchitis, and they are best advised to avoid voluntary exposure. Allergic contact dermatitis from repeated exposure to chemical-based control agents has been identified in both law-enforcement officers and demonstrators at protests.[20] Susceptible individuals should avoid repeated exposure to these gases by standing away from police barricades.

RECOMMENDATIONS

Now the political situation has been changed and those who were under the police aggression are ruling the country. Therefore it is rational to start with few democratic steps towards the use of untested and harmful chemical warfare agents. In this regards, His Majesty's Government should make available the following to the public and health professionals: (1) the chemical composition of all tear gas compounds being used within Nepal; (2) information on the concentrations and various formulations of these agents; (3) previous toxicology studies done by, or available to, the Nepal Police, other security forces; and (4) any other technical information relevant to understanding their health and medical consequences.

His Majesty Government should encourage scientists and medical research personnel in Nepal to undertake all necessary epidemiological and clinical studies to elaborate the health effects of tear gas agents in use in Nepal. This research must be objective and independent. It should include the acute, the sub-acute, the long-term and the chronic effects of these agents. Studies should encompass the effects of these agents on the high-risk populations of the elderly, infants and children, individuals with pre-existing chronic diseases and hospitalized patients. All involved in the research should be assured unequivocally that there will be neither reprisals nor attempts to influence or bias these investigations.

His Majesty Government should provide adequate medical care to all exposed to tear gas agents who seek or need care and should ensure that cost of services or fear of arrest be no barrier.

CONCLUSION

In conclusion, the use of irritant incapacitants is common in the civil disobediences in spite of their harmful effects in human health and its ban by different organization. The most commonly used riot-controlling agents used as fumigant includes pepper spray or OC (Oleoresin Capsicum) and different types of tear gases, which are O-chlorobenzylidene malononitrile or CS, and omega- chloroacetopheonone or CN, dibenz 1,4-oxazepine or CR and different types of solvent used to disperse these agents. These gases are responsible for the acute and chronic health effects and cause significant impact on the economy. They are responsible for not only the acute and chronic health effects ranging from severe flu-like symptoms, to pulmonary edema and acute respiratory distress, but also for the chromosome aneuploidy in germ and somatic cells leading to birth defects in offspring and cancer. The only immediate physical symptoms developed by a victim of these gases are the irritating and immediately debilitating effects of these tear gases. Apparently, the immediate acute effects of the gas wear off within ten to fifteen minutes. Pepper spray, the most recent chemical agents widely used in the personal defense and riot controlling situations, is the least toxic agents used among all because of its transient effects on health and has been recommended for personal aerosol protection devices. Although the chemical agents have been used for many years, full extent of effects on health is far beyond our understanding. All manufacturers and the police department must disclose the material data safety sheets of all chemicals used in crowd control. Manufacturers should be responsible for the acute and chronic health effects of the chemicals they create and the government should take responsibility for timely aftercare of exposed.

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