

## Short-term and long-term physical effects of exposure to CS spray

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### SUMMARY

CS gas (2-chlorobenzylidene malonitrile) is widely used in an incapacitant spray that causes intense lacrimation, blepharospasm and burning sensations in the throat and nose. Questions have been raised about its safety. We obtained information on short-term and long-term symptoms, and performed ear, nose and throat examinations and respirometry at 8-10 months, in 34 young adults who had been exposed to CS spray in a confined space during a confrontation with police. The group was subdivided into those who had been sprayed directly on the face ( $n=10$ ) and those exposed indirectly.

At one hour, all but 2 individuals still had symptoms; respiratory and oral symptoms were significantly more prevalent in the directly exposed group. At one month, only oral symptoms were significantly more prevalent. At 8-10 months, symptoms were still reported but there were no differences between the groups and clinical examinations revealed no specific abnormalities.

There was no convincing evidence of long-term physical sequelae from exposure to CS spray.

### INTRODUCTION

CS gas [2-chlorobenzylidene malonitrile] is the most commonly used 'tear gas' in the world. The CS incapacitant spray used by UK police forces contains a solution of this compound and is stored in hand-held canisters. Exposure to the spray causes distressing symptoms including lacrimation, eye pain, blepharospasm, a burning sensation in the throat and nose, increased nasal secretions, chest tightness, sneezing, coughing and retching. These effects develop within 20 seconds of exposure and start to wear off within 15 minutes if exposure ceases.

Data on the safety of CS spray are scarce, and there is wide acknowledgment that further studies are required. Here we report observations in a cohort of 34 young adults simultaneously exposed to CS spray.

### THE INCIDENT

34 young adults (15 men, 19 women, age range 21-39, mean age 26) were exposed to CS spray during an altercation with the police. They were trapped inside a single-decked 72-seated coach while the spray (standard police issue) was directed towards the group from both the

front and back doors by four police officers. It was winter and the windows of the coach were all closed. To avoid the CS spray the group at first congregated in the middle of the coach. According to the police officers the CS spray was used intermittently as directed, for no more than 3 minutes in all, and the whole group were out of the coach and in the fresh air within about 10 minutes.

### FOLLOW-UP

The first interview with the exposed individuals was one month after the incident. All 34 were questioned about contact with CS spray (direct in the face or indirect) and were asked about adverse effects experienced 1 hour post-exposure and at the time of the interview. The following possible effects were enquired about specifically: ocular (pain, watering, blurred vision); nasal (pain, irritation, sneezing, rhinorrhoea); oral (pain, ulceration, excessive salivation); throat (irritation, burning, pain); respiratory (shortness of breath, chest tightness, cough, wheeze, exacerbation of asthma); gastrointestinal (dysphagia, retching); loss of consciousness; and skin peeling, eczema or rash.

10 individuals (7 men) stated that they had been hit directly in the face by the spray and were categorized as 'direct contact'. The other 24 (8 men) had managed to avoid direct contact but all had experienced symptoms from the spray. Table 1 records the symptoms in the direct and indirect contact groups, with statistical comparisons. The

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Table 1 Findings on follow-up, direct (n=10) and indirect (n=24) contact groups

Symptoms	1 hour		1 month		10 months	
	Direct	Indirect	Direct	Indirect	Direct	Indirect
Ocular	10	22	6	12	1	0
Nasal	5	5	2	4	0	0
Oral	4	1*	5†	0**	0	0
Throat	7	13†	8	12	0	0
Respiratory	10	13	5	9	1	4
Gastrointestinal	5	8	0	0	0	0
Rashes	3	1	1	0	1	0
Black-outs	1	1	0	0	0	0
Others	0	0	2	3	1	2

\* $P < 0.02$  ( $\chi^2$ ); †  $P < 0.02$  (Fisher's exact test); ‡  $P < 0.001$ 

most frequent symptoms experienced one hour after exposure were in the eyes, respiratory system and throat. 2 individuals said they had experienced a black-out. The only symptoms significantly more prevalent in the direct contact group at one hour were respiratory and oral.

At one month, symptoms were still frequent, but only oral symptoms were significantly more prevalent in the direct-exposure group.

At eight to ten months, all those in the cohort were reviewed by a consultant ear, nose and throat surgeon. They were questioned about symptoms, and the examination concentrated on a search for inflammatory changes in the mucous membranes of the upper respiratory tract and the eye. In addition, respiratory function tests were done by a trained nurse. On this occasion, 5 individuals reported respiratory symptoms (1 from the direct contact group, 4 from the indirect contact group); 2 had worsening of asthma, 2 had decreased exercise tolerance, and 1 complained of coughing fits after exercise. 1 had developed a rash seven months after exposure to the spray. 1 individual from the direct contact group reported ocular ulcers but these were not seen on examination at this stage. 'Other' symptoms included intermittent paraesthesiae in the arms (1, direct contact) and aching joints and hip pains (2, indirect contact). There were no between-group significant differences in symptoms. Neither physical examination nor spirometry revealed any evidence of continuing morbidity.

## DISCUSSION

A weakness of this cohort study is that we could not accurately determine the times and extents of exposure to the CS spray in individuals. Furthermore, the reporting of

symptoms—especially the retrospective record of those present 1 hour after exposure—was probably inaccurate. There may have been a temptation to exaggerate, in the hope of financial compensation. If our findings had pointed to long-term ill-effects, these would have been important considerations. The data, however, are reassuring rather than the reverse.

Toxicology data on CS are limited, much of the research being military and some classified as secret.<sup>1</sup> In 1969 the British Home Office concluded that 'whilst exposure to CS spray can be lethal in the form of toxic pulmonary damage, leading to pulmonary oedema', such an occurrence would only occur at concentrations that were several hundred times greater than exposure dosage that produces intolerable symptoms which would force the individual to leave the vicinity.<sup>2</sup> In times of conflict such evasive action may not be possible, and in 1988 the Federal Laboratories Inc in the USA suspended sale of the agent.<sup>3</sup> While no proven fatalities have occurred, CS spray has been implicated by the media in the death of one individual during an aggravated arrest.<sup>2</sup>

The modest amount of published work on CS spray, however, points to safety. Serious morbidity, when it has occurred, was probably due to overexposure or overuse. Even in the litigious environment of the United States, where CS spray has been used for 35 years, no damages have ever been awarded to victims.

In Britain the spray used by the police forces contains 5% CS gas, whereas in the United States it contains 1%. There are no scientific data comparing the two concentrations. In 1998 *The Lancet* highlighted confusion over the safety of CS spray and called for a moratorium on its use by police forces.<sup>4</sup> The Department of Health concluded in

1999 that, although CS spray does not raise major health concerns, more research is required.<sup>5</sup>

The 34 individuals in this report were exposed to different concentrations of CS spray for similar lengths of time. Many still had symptoms one month after exposure, especially those sprayed directly, but at ten months there was little difference between the exposure groups and no ill-effects were evident on clinical examination. We conclude that, in this incident when CS was used by the police, the spray caused no long-term physical sequelae.

## REFERENCES

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