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MINISTRY OF SUPPLY

DIRECTORATE OF CHEMICAL DEFENCE RESEARCH AND DEVELOPMENT

CHEMICAL DEFENCE EXPERIMENTAL ESTABLISHMENT

EFFECT ON PUPIL SIZE OF EXPOSURE TO GB VAPOUR

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By

VAN M. SIM

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PORTON TECHNICAL PAPER No. 531

C.D.E.E.
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THE TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN
ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.**

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Porton Technical Paper No. 531

Date 20 JAN 1956

Effect on Pupil Size of Exposure to GB Vapour

By

Van M. Sim^{*}

SUMMARY

Pupil constriction occurs more slowly and is less severe following exposure to a GB vapour dosage of 5 than to dosages of 10 or 15 mg.min./m³.

Protecting the eyes with a bandage decreases the rate of pupil constriction and results in a larger pupil after exposure to GB vapour.

Intramuscular atropine given 30 min. before GB exposure has little effect on the production of eye effects.

(Sgt.) E. Cullumbine,
Supt., Medical Division.

* U.S. Chemical Corps, Medical Laboratories, temporarily attached to C.D.E.E.

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One hundred and thirty six men were exposed with eyes unprotected, thirty three with eyes bandaged and forty two half an hour after intramuscular injection of 2 mg. atropine sulphate. In addition a further twenty nine men were used as controls undergoing the same routine in the chamber with a non-toxic atmosphere. The number of men exposed and the dosage in each group is shown in Table I.

Results

These are summarised in Table 2, where it will be seen that with the eyes uncovered, dosages around 10 and 15 mg.min./m³ produced similar rates and degrees of pupil constriction. This was true whether the exposure time was about 1 or 2 minutes. At a lower dosage (about 5 mg.min./m³) contraction was somewhat slower and the eventual minimum pupil size was somewhat larger than that produced by the higher dosages.

Similarly, with the eyes bandaged or after atropine sulphate, dosages of 10 and 15 mg.min./m³ produced similar effects but the pupil constriction was slower and not so pronounced after 5 mg.min./m³.

With each dosage, bandaging the eyes offered significant protection; the rate of pupil constriction was slowed about five-fold and the minimum - and 48 hr. - pupil sizes were about twice those of uncovered eyes.

The intramuscular administration of atropine 30 min. prior to exposure delayed the constriction of the pupil down to 3 mm. by about 1 min. in those exposed to 10 and 15 mg.min./m³ dosages but had little effect on the rate of constriction in the 5 mg.min./m³ groups. Atropine itself, of course, dilates the pupil so that all those subjects commenced the exposure with their pupils dilated by about 1 mm. diameter above normal. The final pupil size did not greatly differ between those who had received atropine and those who had not.

In the atropine groups the pupillary diameter appeared to remain constant, or nearly so, for several minutes, and then to contract fairly rapidly; however, the pupils in the unprotected groups contracted progressively from the beginning, eventually reaching the same level of constriction in a comparable period.

There is no indication from these experiments that the occasional subject may have a very rapid drop in pupillary constriction time at the Ct's given. This would lead one to believe, at least at these dosages, that if pupillary constriction were to be used as a field method of detecting whether or not a person had been exposed, it would have questionable value.

Some of the subjective complaints noted were of interest. The most common unrehearsed description by different individuals in various groups was that they felt "they had blinkers on"; or, that "it feels like you are looking down a gunbarrel". These remarks were entirely spontaneous and usually occurred shortly after exposure. Bright lights or exposure to bright sunshine definitely increased the eye pain. Focussing on nearby subjects, such as looking at the finger close to the nose caused an increase in the pain.

Atropine given pre-exposure in most instances seemed to give relief from eye pain for about six hours, but after that time there was no apparent difference between the groups. There was a definite impression that pre-injection of atropine lessened both the frequency and the degree of suffusion present.

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Summary

Pupil constriction occurs more slowly and is less severe following exposure to a GB vapour dosage of 5 mg.min./m³ than to dosages of 10 or 15 mg.min./m³.

Protecting the eyes with a bandage decreases the rate of pupil constriction and results in a larger pupil after exposure to GB vapour.

Intramuscular atropine given 30 min. before GB exposure has little affect on the production of eye effects.

Acknowledgement

J.P. Dowdall and G.A. Kirkham of the Chemistry Section were responsible for the establishment and the analysis of the GB vapour concentrations. P.O. M.I. Jones, R.N. and J./T. J. Carpenter, R.A.F., assisted in the measurements on the subjects.

(Sgd.) H. Cullumbine,
Supt., Medical Division.

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Table 1

No. in Group	Nominal GB Vapour Concentration mg./m ³	Exposure Time Minutes
<u>Unprotected</u>		
38	15 mg./m ³	1
54	7.5 mg./m ³	2
12	10 mg./m ³	1
22	5.0 mg./m ³	2
5	5 mg./m ³	1
5	2.5 mg./m ³	2
<u>Bandage</u>		
5	15 mg./m ³	1
10	7.5 mg./m ³	2
3	10 mg./m ³	1
5	5 mg./m ³	2
5	5 mg./m ³	1
5	2.5 mg./m ³	2
<u>Atropine</u>		
16	15 mg./m ³	1
5	7.5 mg./m ³	2
6	10 mg./m ³	1
5	5 mg./m ³	2
5	5 mg./m ³	1
5	2.5 mg./m ³	2
<u>Controls</u>		
29	Nil	Nil

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Table 2

Changes in Pupil Size Following Exposure to GB Vapour with Eyes Covered and Uncovered and Following 2 mg. Atropine Sulphate I.M.

	No. of men	Doses of GB mg/ml/m ³	Concn. GB mg/m ³	Time of Exposure min.	Time to Contract to 3 min. min.	Minimum Pupil Size (mm.)	Pupil Size at 48 hr.
Eyes Uncovered	38	14.4 - 15.0	12.8 - 15.3	0'59" - 1' 6"	6.6 (6.0 - 7.5)	1.5	1.6 (1.5 - 2.0)
	54	13.1 - 15.4	5.5 - 7.6	1'52" - 2'23"	5.7 (4.5 - 6.5)	1.5	1.5
	12	10	9.5	1' 3"	5.0 (4.5 - 5.5)	1.7	1.8 (1.7 - 1.9)
	22	5.3 - 9.8	4.0 - 4.5	2' 0" - 2'13"	6.0 (5.0 - 7.0)	1.6	1.8 (1.5 - 2.0)
	5	4.5	4.3	1' 3"	10.0 (9.5 - 10.5)	1.8	1.8 (1.5 - 2.0)
	5	5.0	2.8	2' 8" - 2'13"	9.1 (6.5 - 11.0)	1.8	1.9 (1.5 - 3.0)
Eyes Bandaged	5	14.2 - 15.3	14.1 - 15.1	0'59" - 1' 1"	34.0 (32.0 - 36.0)	3.0	3.0
	10	14.2 - 15.1	6.2 - 7.5	2' 5" - 2'17"	36.0 (32.0 - 40.0)	3.0	3.3 (3.0 - 3.5)
	3	10.5	10.7	0'59"	34.0 (30.0 - 38.0)	3.0	3.5
	5	10.1	4.2	2'24"	35.0 (30.0 - 40.0)	3.6	3.6 (3.0 - 4.0)
	5	5.4	4.8	1' 6"	41.0 (32.0 - 50.0)	3.7	3.7 (3.0 - 4.0)
	5	4.7	2.5	1'54"	57.0 (50.0 - 60.0)	3.7	3.8 (3.5 - 4.0)
After 2 mg. Atropine I.M.	16	14.9 - 15.3	14.1 - 15.1	0'59" - 1' 5"	7.0 (6.5 - 7.5)	1.8	2.0 (1.8 - 2.2)
	5	14.7	7.9	1'52"	6.8 (6.0 - 7.5)	1.7	1.8 (1.7 - 1.9)
	6	10	9.0	1' 7"	6.0 (5.5 - 6.5)	1.7	2.0
	5	3.1	4.7	1'55"	6.9 (6.0 - 8.0)	1.7	2.0 (1.5 - 2.1)
	5	5.2	5.2	1' 0"	7.8 (4.5 - 10.0)	2.2	2.4 (2.0 - 3.0)
	5	4.2	2.3	1'50"	9.5 (8.0 - 11.0)	2.5	2.7 (2.5 - 3.6)
Controls	29	Nil					No Changes in Pupil Size

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