

Original Article

Visual Evoked Potentials Changes among Patients with Chronic Mustard Gas Exposure

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Abstract

Purpose: To report the chronic effect of mustard gas exposure on visual pathway measured by visual evoked potentials.

Patients and Methods: The present study included 150 participants in three groups. The case group included 50 patients with chronic mustard gas exposure inflicted on them during the Iran - Iraq war (1980 - 1988). The first control group included fifty veterans of the Iran - Iraq war with no history of exposure to mustard gas and the second control group included 50 age and sex matched participants with no history of involvement in the war. Visual evoked potentials including latency and amplitude of VEP, P100 peak wave were measured in all participants and were compared between groups.

Results: The result of the present study showed significant delay in mean latency of VEP, P100 peak in the case group compared to both control groups, while the difference in amplitude of VEP, P100 peak was not statistically significant.

Conclusion: A significant delay in the latency of VEP, P100 peak among patients with a chronic history of mustard gas exposure was found which might be due to disturbances in visual pathway caused by mustard gas exposure.

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Introduction

Along with the conventional weapons chemical weapons including sulphur mustard were widely used by Iraqi forces against Iranian troops during Iran - Iraq war of the 1980s ¹. Sulphur mustard, also known as mustard gas is an alkylating compound, which has a number of acute and chronic effects on the exposed victims ^{2,3}. The acute effects start with eye itching, skin blistering and vomiting after mustard gas exposure ³. Early ocular complications of mustard gas exposure include signs of corneal penetration, conjunctival necrosis, corneal vascularization as well as ulceration and in severe cases corneal perforation within a few minutes ³⁻⁵. Eye symptoms usually worsen and many patients complain of temporary blindness due to blepharospasm and lid edema ^{3,4}. The chronic or long term adverse effects of mustard gas are observed in skin, eye, and respiratory system ^{2,5}. Chronic ocular complications include photophobia, decreased vision, dry eye sensation, foreign body sensation, tearing and pain ⁶⁻⁹. One of the widespread techniques to study pathological disturbances in visual pathway is visual evoked potential (VEP) ¹⁰. VEP is the recording of electrical activity of visual cortex created by stimulation of the visual system ¹⁰. There are limited references available on the effect of mustard gas on visual pathway ⁵. The aim of the present study was to evaluate the possible effects of mustard gas exposure on visual pathway using VEP technique.

Patients and Methods

The present study was approved by the ethics committee of Basir Eye Health Research Center, Tehran, Iran, and all participants gave written consent before entering the study.

Fifty war veterans with a history of chronic mustard gas exposure inflicted on them during the Iran - Iraq war (1980-1988), with normal uncorrected visual acuity (UCVA) or best corrected visual acuity (BCVA) with use of suitable glasses, were selected randomly from a total population of 210 war veterans exposed to mustard gas as the case group. The veterans all reported experiencing skin, eye and respiratory system problems as an acute effect after mustard gas exposure. The first control group included fifty veterans of the Iran - Iraq war with no history of exposure to mustard gas and the second control group included 50 age and sex matched participants with no history of involvement in the war. The exclusion criteria were any other known eye disease except for exposure to mustard gas, a history of eye trauma or surgery and any systemic diseases affecting the visual pathway. Visual evoked potentials (VEP) using pattern reversal checkerboard were recorded in all participants. The specification of parameters selected to record VEP patterns in the study population are listed as follow: amplification (Gain × 1000: 200), filtering (low cut frequency 0.3 Hz, high cut frequency 35 Hz), test duration 500 ms, number of cycles:75, artifact level 100 %, check board resolution: 5 × 5, contrast 100 %, back colour: black, active colour: white, fixing colour: red. A Pantops-PC2 (Biophysic Medical, Clermont-Ferrand, France) machine was used for recording VEP in all participants. Three electrodes (active, reference and ground) were used to connect the machine to the subject head base on conventional electrode attachment method. Latency and amplitude of VEP, P100 peak were measured for each participant. The results obtained from three groups were compared to evaluate the possible differences in VEP readings. SPSS statistical program version 20 (Armonk, NY:

IBM Corp.) was used to analyze the results.

Results

The mean age of participants in the case group and the first and second control groups was 46.54 ± 2.48 years, 45.64 ± 2.62 years and 45.12 ± 2.72 years respectively, showing no statistically significant difference. The mean latency of VEP, P100 peak in the case group and the first and second control groups was 112.08 ± 4.55 msec, 97.12 ± 4.6 msec and 96.16 ± 4.63 msec respectively, showing a statistically significant increase in the case group compared to both control groups ($P < 0.001$) (Table 1). The mean amplitude of VEP, P100 peak in the case group and the first and second control groups was 6 ± 1.3 μ v, 5.98 ± 1.4 μ v and 5.96 ± 1.33 μ v respectively showing no statistically significant difference between the case and control groups (Table 1).

Discussion

While the acute effects of mustard gas have been relatively well characterized, the chronic effects of short term but significant exposure to this chemical agent are still not fully defined^{1,4}.

It is known that the latency of VEP, P100 peak is related to the visual pathway function¹¹; therefore delay in the latency of VEP, P100 peak in patients with chronic mustard gas exposure might be due to disturbances in visual pathway caused by the gas toxicity on

nervous system.

In our search of English language literature we only found one previous study regarding the chronic effect of mustard gas exposure on visual pathway. In that study performed by Riazi et al.,⁵ in 2014, the authors compared the VEP findings from 36 veterans of Iran-Iraq war with a history of mustard gas exposure and a control group of 15 healthy volunteers. Contrary to our findings showing significant difference in latency of VEP, P100 peak among patients with a history of mustard gas exposure Riazi et al.,⁵ did not observe such a difference. A probable reason for this difference might be their smaller sample size specially their small control group of only 15 volunteers. This difference in our findings shows the need for further studies evaluating the visual pathway and VEP findings among patients with a history of mustard gas exposure.

Shahriary et al.,¹² evaluated the long term effect of a single dose of mustard gas on nerve conduction velocity and electromyography in hind limb of male rats and observed high prevalence of peripheral neuropathy. Similarly Holisaz et al.,¹³ have reported peripheral neuropathy in a population exposed to mustard gas¹³. Since the visual pathway is functionally similar to peripheral neurons these studies showing the long term effect of mustard gas exposure on peripheral nervous system might suggest a similar effect on visual pathway like what was observed in the present study as

Table 1: Comparison of VEP, P100 peak among war veterans with chronic exposure to mustard gas (The case group), war veterans not exposed to mustard gas (The first control group), and participants with no history of involvement in the war (The second control group)

VEP, P100 peak readings	Group			P*
	The case group	The first control group	The second control group	
Latency (msec)	112.08 ± 4.55	97.12 ± 4.6	96.16 ± 4.63	< 0.001
Amplitude (μ v)	6 ± 1.3	5.98 ± 1.4	5.96 ± 1.33	0.98

increased latency of VEP, P100 peak.

Conclusion

A significant delay in the latency of VEP, P100 peak among patients with a history of mustard gas exposure was found which might be due to disturbances in visual pathway caused by

mustard gas exposure.

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Footnotes and Financial Disclosures

Conflict of interest:

The authors have no conflict of interest with the subject matter of the present study.