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Short Report

An Evaluation of Neuromuscular Reversal with Edrophonium in a Patient with Malathion Intoxication

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MATSUKAWA, S., HASHIMOTO, Y., KATO, M., HOSHI, K., SATOH, D., HORINOUCHI, T., SATOH, S. and SAISHU, T. *An Evaluation of Neuromuscular Reversal with Edrophonium in a Patient with Malathion Intoxication.* Tohoku J. Exp. Med., 1997, **181** (4), 467-469 —— We evaluated the neuromuscular reversal with edrophonium using peripheral nerve stimulator and recorder in a patient with malathion intoxication. Edrophonium 10 mg i.v. caused an increase in single twitch tension by 76% of the control during the recovery phase from an acute cholinergic crisis 16 days after ingestion of malathion solution. The present study indicated that edrophonium test seems to be a reliable monitoring in evaluating neuromuscular reversal in the patient with acute malathion insecticide poisoning. ———— malathion intoxication; edrophonium; cholinergic crisis; neuromuscular reversal

The acute toxicity of cholinergic agents (i.e., carbamates, organophosphorus compounds, sarin, soman or VX gas) can be explained by inhibition of the enzyme acetylcholinesterase (Tafuri and Roberts 1987). This results in an increase in the amount of acetylcholine that remains active in the synaptic creft, causing sustained depolarization of the post synaptic neuron. Symptoms of cholinesterase-inhibitor poisoning in nicotinic sites at the neuromuscular junction are characterized by paralysis of proximal limb muscles, neck flexor, motor cranial nerves, and respiratory muscles (Jackson 1991).

Edrophonium (4-10 mg) is used for the assessment of the efficiency of anticholinesterase therapy and of the type of crisis (i.e., myasthenic, cholinergic, brittle type) in the patients with myasthenia gravis (Foldes 1975). Based on

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these findings, the effect of edrophonium on twitch response elicited by peripheral nerve stimulation was evaluated in a patient with malathion [S-1, 2-bis (ethoxycarbonyl) ethyl O, O-dimethyl phosphorodithioate] intoxication.

Subject and Methods

The patient was a 37-year-old housewife with a history of neurosis, who ingested approximately 40 ml of 50% malathion solution in a suicide attempt. Two days after the ingestion, she entered the ICU of Tohoku University Hospital for the treatment of cholinergic crisis i.e. increased secretions, miosis, fasciculations, disturbance of consciousness and muscle weakness, necessitating endotracheal intubation and mechanical ventilation. Plasma cholinesterase activity was less than 10% of baseline value (0.34 IU/liter; normal range 4.25-7.25 IU/ml). The medical treatment with atropine (total 7 mg) and pyridine 2-aldoxime methiodide (PAM, total 5,500 mg) started at the admission of ICU.

During the patient stay in the ICU, the ulnar nerve was stimulated indirectly at the wrist using a Nihon Kohden SEN-1101 stimulator (Nihon Kohden, Tokyo) with supramaximal square-wave stimuli of 0.1 msec duration through 1.2×1.2 cm surface electrodes placed 3 cm apart near the ulnar nerve at the wrist. The electrical stimuli were applied continuously with 0.1 Hz, according to the need. Trains of stimuli of 2 Hz were also derived for 15 sec. The resultant force of

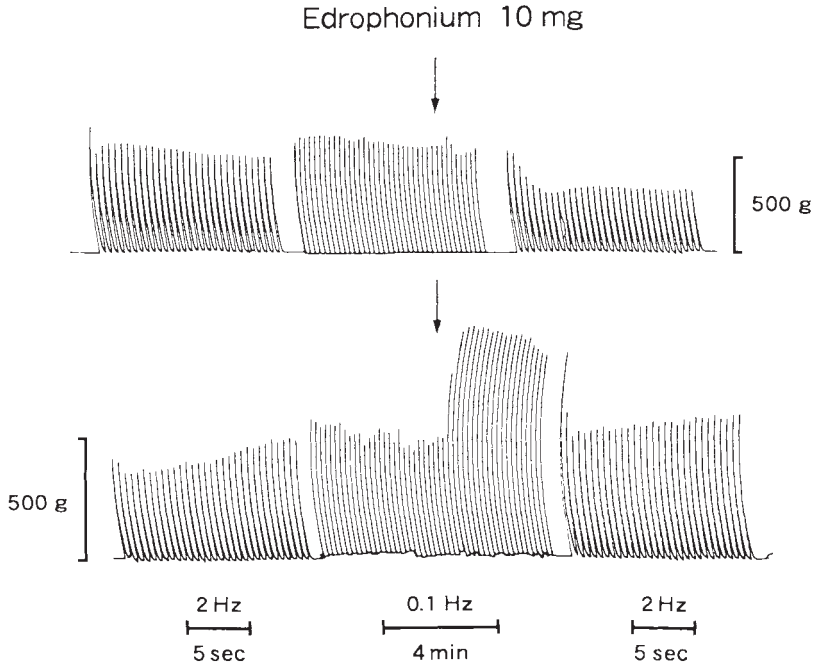

Fig. 1. Continuous tracings of the effects of edrophonium on single and repetitive twitch responses from the adductor pollicis muscle. An i.v. injection of edrophonium caused decreases in single and repetitive twitch tension during acute cholinergic phase (upper trace). During recovery from cholinergic phase 16 days after the ingestion, edrophonium 10 mg i.v. resulted in an increase in single twitch by 76% of the control (lower trace).

adduction (twitch tension) of adductor pollicis muscle was recorded using a force-displacement transducer attached to a recorder (Nihon Kohden multipurpose polygraph).

Results and Discussion

On the 4th day in the ICU, a slight decrease in tension was observed by the trains of stimuli. The i.v. administration of 10 mg of edrophonium caused decreases in single and repetitive twitch tension (Fig. 1, upper trace). This indicates that the patient was thought to be in the phase of cholinergic crisis. On the 14th day after admission to the ICU (16 days after ingestion of malathion solution), an initial transient decrease followed by facilitation in tension was observed by the trains of stimuli. An increase in single twitch tension by 76% of the control was found immediately after i.v. administration of edrophonium 10 mg (Fig. 1, lower trace).

The principal goal of neuromuscular recovery in the patient with cholinergic toxicity is the re-establishment of spontanous respiration and the ability to protect the airway from aspiration. Sensitive tests of pulmonary function such as vital capacity, maximum voluntary ventilation, and maximum inspiratory pressure are difficult to perform when the patient is persisting in the symptoms of confusion, obtundation, coma and seizure. Observation of the evoked responses from the muscle to nerve stimulation are then appropriate.

Edrophonium possesses direct agonistic action on nicotinic receptors in addition to its repetitive nerve and muscle firing actions, which can produce tetanic response (Aracava et al. 1987). Likewise, edrophonium has rapid onset and short duration of action, and few muscarinic side effects. Significant potentiating response to edrophonium (Fig. 1, lower trace) indicates the return of the sensitivity of the endplate to acetylcholine. Edrophonium, therefore, appears to be a suitable diagnostic agent for poisoning of cholinergic agents.

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