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ORIGINAL ARTICLE

Prospective study on the efficacy of optokinetic training in the treatment of seasickness

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KEYWORDS
Seasickness;
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Optokinetic training

Summary
Objectives: Seasickness corresponds to all of the clinical symptoms experienced by a subject at sea related to boat movements. The objective of this study was to evaluate the efficacy of optokinetic training versus placebo in the treatment of seasickness.
Material and methods: Fifteen subjects were randomized to either an optokinetic training arm or a placebo arm. The impact of seasickness was evaluated for each subject before and after optokinetic training using the Graybiel scale.
Results: Among the trained subjects, 71.4% were improved by optokinetic training versus 12.5% of control subjects. A significant difference was observed for Graybiel scores before and after optokinetic training in the training arm.
Conclusion: Optokinetic training appears to be an effective modality for the management of disabling seasickness. This training can be further improved by more global patient management.

Introduction

Seasickness is a common disease, familiar to all sailors and corresponds to all of the clinical symptoms experienced by a subject at sea related to boat movements. The usual symptoms are characterized by a feeling of general malaise, drowsiness, and cold sweating, rapidly followed by vomiting [1]. Other clinical forms have also been described, such as sopite syndrome, characterized by psychomotor slowing and drowsiness [2]. Sea travel is the mean of transport most frequently associated with motion sickness. Seasickness has a peak frequency between the ages of 2 and 12 years with a female predominance [3].

The pathophysiology of seasickness appears to involve several different mechanisms. Stimulation of the vestibular system is a central element in development of symptoms. The otolith organs, constituting real gravitoinertial accelometers, are intensely stimulated while at sea [4]. This effect is compounded by the sensory mismatch due to conflicting visual, vestibular and proprioceptive input to vestibular nuclei. There is also a permanent comparison

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Table 1 Graybiel scale.

	16 points	8 points	4 points	2 points	1 point
Nausea syndrome	Vomiting	Major nausea	Minor nausea	Epigastric discomfort	Epigastric awareness
Skin colour		Major pallor	Minor pallor	Minimal pallor	Flushing
Cold sweating		Major	Minor	Minimal	
Drooling		Major	Minor	Minimal	
Drowsiness		Major	Minor	Minimal	
Pain					Headache
Central nervous system signs					Dizziness

between instantaneously perceived data and data recorded in an internal model, the ''neural store'' [5]. This neural store also appears to be responsible for feedback inducing central sensory rearrangement allowing adaptation phenomena. Other hypotheses, especially involving postural disorders, have also been subsequently developed [6]. Olfaction and psychological factors such as marked anxiety or sudden stress are also suspected to be involved [7].

A wide range of drug treatments are now available, including antihistamines such as dimenhydrinate and diphenhydramine [8] that act on vestibular H1 histamine receptors and exert a central anticholinergic action. Anticholinergic drugs such as scopolamine that acts on muscarinic receptors have also been shown to be effective and are essentially used in the form of transdermal patches allowing a longer duration of action [9]. However, these treatments are associated with serious adverse effects such as drowsiness, somnolence, and visual disorders [10]. Finally, dopamine antagonists with an action on vomiting centres can be used to treat gastrointestinal symptoms, but can also cause adverse effects, such as extrapyramidal syndromes. Non-pharmacological treatments with variable efficacy are also known to sailors, such as breathing control [11], P6 acupressure, stimulating the acupuncture point controlling the vomiting centre [12], or the use of glasses with a fictitious horizon line that changes with boat movements.

A rehabilitation technique using optokinetic stimulation exercises has been developed in our department and appears to give good results in sailors refractory to all other treatment options. The objective of this study was to objectively determine the real efficacy of this technique versus placebo.

Material and methods

The primary objective of this single-centre, single-blind, placebo-controlled interventional study was to evaluate the efficacy of optokinetic training. This study was approved by the Clermont-Tonnerre military hospital Ethics Committee and lasted 1 year.

Recruitment for this study initially concerned Marine Nationale (French Navy) personnel and was subsequently extended to civilian volunteers.

Inclusion criteria

Subjects with seasickness greater than stage II according to the criteria of the Graybiel scale, in whom medical treatment was insufficiently effective or associated with disabling adverse effects, and in whom no embarkation was planned during the training period.

Exclusion criteria

Military personnel classified as unfit to sail, subjects unlikely to sail after completing training or subjects with a history of ear, nose and throat disease such as unilateral or bilateral vestibular deficit, cochleovestibular disease, tympanum disease, and finally subjects who had already completed optokinetic training.

The endpoint was seasickness less than or equal to stage II after optokinetic training.

Thirty volunteers were randomized to two arms, an optokinetic training arm and a placebo training arm, and subsequently underwent clinical interview and initial assessment.

The initial assessment was conducted in several parts. The first part consisted of clinical interview looking for a history of ear, nose and throat disease and physical examination. An initial evaluation of the severity of seasickness was also performed by using the Graybiel scale (Tables 1 and 2), attributing a certain number of points as a function of the symptoms reported by the subject. The following signs were evaluated:

- nausea syndrome;
- skin colour;
- cold sweating;
- drooling;
- sleepiness;
- headaches and dizziness.

The number of points attributed was used to calculate a severity score and determine the stage of seasickness [13]. The Graybiel scale was administered as a physician-administered questionnaire. The physician performing the evaluation in the context of the protocol was blinded to the arm to which the subject had been randomized. Finally, subjects received oral and written information about the study and signed an informed consent form during this interview.

The subjects then performed functional tests including:

- videonystagmography looking for spontaneous nystagmus, studying optokinetic nystagmus, saccadic movements and pursuits, a calibrated caloric reflex test and rotational