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Abstract

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THE OCULOCARDIAC REFLEX AND VISUAL TRAINING

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ABSTRACT

The oculocardiac reflex is a change in heart rate or rhythm produced by manipulation of the eyes or adnexia. It is known to occur during surgery on the eyes when traction is applied to the extraocular muscles. This study evaluates the possibility that the oculocardiac reflex can be elicited by doing prism rocks. To assess heart rate the subject was connected to a heart rate monitor and to produce the oculocardiac reflex a 20 diopter prism was placed before the right eye. Control data was obtained by use of a plano lens. No significant changes in heart rate were produced by either the prism or the plano lens (t-test for related measures). This suggests that the oculocardiac reflex is not a major problem for normal children doing jump ductions.

KEY WORDS

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INTRODUCTION

The purpose of this research paper is to determine any influence on heart rate by use of a standard optometric visual training procedure. There are numerous visual training techniques that result in traction on the extraocular muscles. Some of the techniques that put stress on the visual system include base out training such as prism rocks, ductions, tranaglyphs, and pencil push-ups. It is possible that these training techniques could elicit an oculocardiac reflex.

The oculocardiac reflex (OCR) is a neurological response of the heart manifested through a reflex arc between the trigeminal and vagus cranial nerves. The opthalmic division of the trigeminal nerve innervates the eye and extraocular muscles and communicates with the nuclei of the vagus nerve in the brainstem. The vagus nerve directly innervates the heart and produces bradycardia when stimulated. Furthermore, since the vagus also innervates other viseral organs another concern of the OCR is its possible role in asthenopia which may be the result of ocular stress. "While the relationship of the OCR to visual training and asthenopia is purely speculative at this time, the relationship of the OCR to surgical mortality has been well documented"(1).

The OCR has been elicited in many ways by different

researchers. Manipulating facial areas innervated by the fifth nerve or placing the face in cold water may elicit the response. A relaxing technique known as Palming may also elicit the response. "This requires nothing more than taking warm hands (rub the palms together briskly until you feel their heat) and placing the palms over closed eyelids. Sometimes while you are palming, roll your eyes to the sides and up and down to feel the muscles stretch, and then relax them, letting them sink into the deep eye caves"(2). Strabismus surgery on children is a major way of eliciting the OCR because of the tugging on the extraocular muscles.

The OCR may be prevented or treated by retrobulbar block to keep the response from starting or systemic injection of atropine to keep the response from the heart. Either method may not stop the response completely but will keep it from being great enough to create a cardiac arrest. Since the OCR happens while traction is applied on the extraocular muscles during strabismus surgery there has been concern about the traction on the extraocular muscles while doing certain visual training procedures.

In the study described below, a 20 diopter prism was used to produce a rapid eye movement and heart rate was monitored to determine if the oculocardiac reflex could be elicited by this procedure.

METHODS

SUBJECTS: The subjects (N=23) used in this research were individuals with normal binocular vision under the ages of 12 years and over 20 years. The younger group (N=11) consisted of children of optometry students ranging in age from 3 to 12 years old with a mean of 7.8 and standard deviation of 2.79. The older group (N=12) was comprised of optometry students ranging in age from 20 to 30 with a mean of 26 and a standard deviation of 2.39. The reason for these two groups is because the literature indicates that young people are more susceptible to the OCR than are older people(3).

EQUIPMENT: Heart rate was evaluated by the Grass Model 7B Polygraph that was designed for electrocardiogram recordings. Recording involved placing surface electrodes on the wrists and ankles of the subject. These electrodes record nerve impulses on a paper tape moving 10mm/sec. Heart rate was determined, both with and without lenses, by measuring the time between 10 consecutive peaks of the QRS wave and converted to beats per second.

STIMULUS: The visual training technique used involved placing a 20 diopter prism base out in front of the right eye to produce convergence. The magnitude of this prism was selected because it forces an individual with normal binocular vision to the limits of positive fusional

convergence. This binocular convergence can produce traction on the lateral rectus muscles of each eye.

The fixation target used was a penlight held at 40 centimeters from the eyes. The penlight being a gross fixation target was selected to demand convergence without much accommodative demand.

PROCEDURE: Subjects were asked to sit quietly for 20 seconds while base line heart rate data were recorded. This was followed by 10 seconds of prism induced sustained convergence. Another 20 seconds of base line heart rate was recorded followed by 10 seconds of a placebo plano lens. The order of use of the prism and plano lenses were alternated across subjects to counterbalance ordering effects.

RESULTS

The data from the electrocardiogram recordings were measured and the differences between the base line heart rates and heart rates with lenses were calculated. Changes in heart rate were compared between the prism and the plano lens using a t-test for related measures (Table 1 & 2). No significant difference was found between the mean heart rates for the under 12 age group ($t = -.357$, $p = .68$) nor for the over 20 age group ($t = .126$, $p = .60$). Furthermore, when inspecting recordings of individuals no transient cardiac

arrhythmia was found.

TABLE #1: UNDER 12 AGE GROUP

		HEART RATE: BEATS PER SECOND			
SUBJECTS	AGE	BASE 1	PRISM	BASE 2	PLANO
1	10	1.80	1.72	1.92	1.82
2	10	1.49	1.45	1.37	1.47
3	8	1.85	1.85	1.96	1.80
4	12	1.49	1.47	1.46	1.54
5	4	1.72	1.71	1.80	1.67
6	6	2.13	2.04	2.08	2.06
7	8	3.25	2.78	3.17	2.94
8	6	1.72	1.59	1.75	1.61
9	10	1.39	1.41	1.39	1.39
10	9	1.68	1.68	1.68	1.69
11	3	2.04	2.13	2.13	2.13
MEAN DIFFERENCES			-.066		-.059

TABLE #2: OVER 20 AGE GROUP

		HEART RATE: BEATS PER SECOND			
SUBJECTS	AGE	BASE 1	PRISM	BASE 2	PLANO
1	25	1.01	1.03	1.03	1.03
2	30	1.27	1.20	1.30	1.35
3	28	1.59	1.61	1.67	1.63
4	27	1.19	1.19	1.20	1.17
5	26	1.27	1.29	1.28	1.30
6	28	1.19	1.22	1.20	1.18
7	26	1.18	1.10	1.15	1.14
8	26	.97	1.02	1.04	1.02
9	25	1.02	1.05	1.04	1.07
10	26	1.30	1.30	1.43	1.32
11	26	1.32	1.25	1.43	1.56
12	20	1.49	1.44	1.56	1.42
MEAN DIFFERENCES		-.0083		-.0117	

DISCUSSION AND CONCLUSION

The OCR is a neurological response to manipulation of the eyes and/or surrounding tissue. Since traction on extraocular muscles during strabismus surgery can elicit an OCR it was thought that maybe traction on the extraocular muscles done by some visual training procedures may also elicit an OCR. From the data it appears that there is no significant fluctuation of heart rate produced in response to

significant convergence caused by base out prism. The results of this experiment indicate that jump ductions and sustained binocular convergence using a 20 diopter prism does not create cardiac arrhythmia in either children or adults.

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