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Case Report

ELECTRICAL VESTIBULAR NERVE STIMULATION FOR THE MANAGEMENT OF TENSION HEADACHE

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ABSTRACT

Tension headache is the most common type of headache and typically it is described as pain or pressure in the head, scalp, or neck, often associated with localized muscle discomfort. It was hypothesized that stimulation of vestibular nerve may relieve pain. In this single-person study, vestibular nerve stimulation was administered daily for a period of 6 weeks. The participant was an 18 years male with a 4 years history of moderate headache at least once week and with repeated periods of moderate stress. He was under medications; however, the pain was not relieved. Stress levels were measured using DASS 21 scale. Pain was measured using pain scale, autonomic, and cognitive parameters recorded by standard methods. During this study, the participant reported a significant reduction in both the frequency and intensity of headaches and by the end of the 6 weeks of the study, it was noticed that he reduced the usage of pain medication. Autonomic parameters remained within normal limits after the periods of stimulation and cognitive functions were improved. This study suggests that electrical stimulation of the vestibular nerve may help to reduce tension headache and highlights the need for larger studies in this area and further exploratory studies in the management of other regional pain such as orofacial pain, dental pain, and management of pain after mandibular surgery.

Keywords: Vestibular stimulation, Head ache, Stress.

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INTRODUCTION

Tension headache is the most common type of headache and can cause mild, moderate, or intense pain in the head, neck, and craniofacial areas. It is more prevalent in females than males [1]. Tension headache most commonly presents in two forms: Episodic and chronic. Episodic headache is defined as having an occurrence of <15 days in a month. The most common causes of tension headache are stress, unusual sleep postures, and excess use of electronic devices [1]. Tension headache can be prevented by relieving stress. Common medications used in the management are ibuprofen and aspirin. These medications do offer temporary relief from headaches though are not always effective and can be associated with side effects. Vestibular stimulation had been reported to relieve pain by multiple mechanisms influencing the cortical and subcortical structures [2,3]. The common methods to stimulate the vestibular system include caloric, linear, rotatory, and electric vestibular nerve stimulation (VeNS). In the present case, electrical vestibular stimulation was applied to manage the tension headache.

Ethical consideration

The study was approved by Institutional Human Ethical Committee of Little Flower Hospital and Research Centre (No EC/17/112-2).

CASE REPORT

Mr. Y is an 18-year male student with a complaint of moderate episodic headache for 4 years which typically occurs at least once a week. This is reported as bilateral headache and with no symptoms of nausea. He currently treats this with Amitone (25 mg). Before this he was on self-medication (ibuprofen) when required. He reported that after taking Amitone, there was significant sedation and discomfort. Standard laboratory investigations were found to be normal. There was no family history of tension headache. He neither smokes nor is alcoholic. He has coffee twice a day and is a non-vegetarian with normal appetite. He very rarely uses of electronic gadgets and spends more time in reading subject books. He reported with poor concentration and significant insomnia. He experiences a moderate level of stress both in personal and professional life. This had a negative impact on his academic performance as well as overall quality of life. There is no reported history of mental illness. Other than a body mass index of 33.4 kg/m^2, his cardiovascular, gastrointestinal, musculoskeletal, and neurological examinations were normal.

Electrical VeNS

Electrical VeNS was administered for 6 weeks. Each daily session was for 1 h, with five sessions being carried out each week. Bilateral application of electrical VeNS using battery-powered vestibular nerve stimulator (ML 1000, Neurovalens, UK) was practiced. It consists of a headset, electrode pads, and skin swabs. Power button helps to turn on the device. The intensity of the stimulation can be controlled manually by the subject using either the buttons on the device or through the Bluetooth mobile app. The electrodes are placed over each mastoid process after cleaning the area with swab, and then through gentle electrical pulse the vestibular nerves get stimulated. It was learnt that this stimulation helped in relaxation and had promoted good sleep [4]. Stress levels were measured using DASS 21 scale. Pain was measured using pain scale. Eating behavior and sleep quality were assessed using eating attitude test scale and Pittsburgh sleep quality index, respectively. Autonomic functions were assessed by recording blood pressure and heart rate. Cognitive functions were assessed by recording the auditory and visual reaction time and through 100 pin dexterity test [2]. All the parameters were measured before (day 0) and after (after 6 weeks) the intervention. The parameters were recorded thrice and an average value was considered. The outcome values are detailed in Tables 1 and 2. There was a significant decrease in the pain score ($p<0.01$), depression ($p<0.05$), anxiety ($p<0.01$), stress ($p<0.01$), and susceptibility to eating disorder ($p<0.05$) followed by the intervention. There was a significant ($p<0.05$) improvement in the quality of sleep followed by intervention. Systolic ($p<0.05$) and diastolic ($p<0.01$)

Table 1: Pain score, psychological, and behavioral parameters before and after the intervention

Parameter	Before intervention	After intervention	p value
Pain score	6.33±0.33	3.67±0.33	0.0048**
Depression	11.67±0.88	8.67±0.33	0.0335*
Anxiety	11.67±0.33	6±0.58	0.0011**
Stress	21.33±0.67	14.67±0.67	0.0021**
Eating attitude test-26 score	22.67±0.67	18.67±0.67	0.0132*
Pittsburgh sleep quality index (sleep quality)	7.67±0.33	5±0.58	0.0161*

Data were presented as mean and SEM. *p<0.05 is significant, **p<0.01 is significant

Table 2: Autonomic and cognitive parameters before and after the intervention

Parameter	Before intervention	After intervention	p value
Systolic blood pressure	125.33±1.76	112.67±3.53	0.0325*
Diastolic blood pressure	80±1.15	72.67±0.67	0.0053**
Pulse rate	86.67±1.76	72±1.15	0.0022**
ART right response	0.318±0.0075	0.104±0.05	0.0178*
ART left response	0.264±0.038	0.138±0.002	0.0309*
VRT right response	0.086±0.038	0.007±0.001	0.1063
VRT left response	0.0283±0.012	0.006±0.0014	0.1580
100 pin dexterity test (S)	296.67±12.02	210±5.77	0.0029**

Data were presented as mean and SEM. *p<0.05 is significant, **p<0.01 is significant

blood pressure decreased and remained within normal limits followed by the intervention. Followed by the intervention, we observed a significant improvement (p<0.05) in the auditory reaction time for both right and left responses wherein the visual reaction time for both right and left responses was not altered. Post-intervention the speed of coordinated movements were significantly improved (p<0.01). The patient was comfortable with the stimulation and is willing to continue. The participant has not reported with increase in stress and episodes of headache during the period of intervention. It was also reported that his sleep quality was improved along with a feeling of increased attentiveness and concentration.

DISCUSSION

The left caloric vestibular stimulation was found to be effective in the management of neuropathic pain [5,6]. Caloric vestibular stimulation was also used to manage the post-stroke pain [7,8]. It was reported that vestibular stimulation activates the parietoinsular vestibular cortex and further leads to the activation of thermosensory cortex and relieves the pain [9]. In the present case, there was significant decrease in the pain score followed by the intervention. It was reported that vestibular stimulation improves motor skills [10]. Interestingly, our findings agree with the previous study as there was significant improvement in the speed of coordinated movements. Vestibular stimulation causes optimal arousal and modulates the processing speed of somatosensory information [11]. Vestibulospinal pathways improve the coordination between the muscles and improve the timing and intensity of the movements [12]. Vestibular stimulation was reported to improve both auditory and visual reaction time in healthy young adults [13]. The improvement in the auditory reaction time followed by the intervention supports the previous studies. However, there was no noted change in the visual reaction time. This may be due to different effects of vestibular stimulation on auditory and visual reaction time, which has to be further studied. Stimulating the vestibular system was reported to influence the blood pressure and heart rate by modulating the baroreceptor reflex [14]. Further, dysregulation of blood pressure was reported followed by damage of vestibular system [15]. Our findings align with earlier studies as blood pressure and pulse rate were regulated and remained within normal limits. It is well known that rocking provides smoothening effect and promotes sleep. Polysomnography studies reported increase in the sleep spindles followed by vestibular stimulation [4]. Our findings support earlier studies as there was a significant improvement in the sleep quality.

CONCLUSION

Although limited to a single-participant observational type study, these findings suggest that electrical VeNS may have a positive influence on the frequency and severity of tension headache and may allow for a reduction in the amount of medication needed for pain management. To further explore these findings, we would recommend larger studies in this area that utilizes control based intervention.

CONFLICTS OF INTEREST

Dr. Jason McKeown is co-founder and CEO of Neurovalens Limited, a medical device company based in Belfast, UK.

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