TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) IN REHABILITATION OF PATIENTS WITH PERIPHERAL VESTIBULAR DISORDERS

Protocol for thesis

Submitted in Partial Fulfillment for the Master Degree

In Audiology

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2009

بسم الله الرحمن الرحيم

"قالوا سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم"

صدق الله العظيم

سورة البقرة – الآية :٣٢

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Introduction:

Postural control involves the coordinate activities of visual, vestibular and somatosensory systems.

The ability to keep our balance and preserve an upright posture instance and gait requires intact labyrinth, cerebellum and cortical vestibular function. Vestibular system is usually evaluated by certain tests according to ***(Furman and Cass 1996)*** such as:

E.N.G **test** ***battery*****:** which assesses the integrity of vestibuloocular reflex (VOR) and detect the presence or absence of organic pathologic condition within central or peripheral vestibular system ***(Baloh and Furman 1989)***, ***Rotational testing*** that provides information how the C.N.S integrates the input from two sensory systems namely the visual and vestibular systems ***(Finberg et al 1987), Computerized dynamic posturography;*** which assesses the standing balance and postural control through measurement the effect of sensor) inputs (visual, vestibular, somatosensory) on postural control ***(Nashner and peters 1990)*** and ***Vestibular evoked myogenic potentials (VEMPs);*** which assess functions of the otoliths in the vestibule which play an important role in rapid adjustment of postural balance and abnormal values suggest lesions in the retro

labyrinthine structures such as inferior vestibular nerve, vestibular neuclei and vestibulospinal tract when a lesion involves brainstem or vestibular pathway ***(Halimagyi and Colebatch 1994).***

Vestibular rehabilitation:

There are several mechanisms involved in the recovery of function following unilateral vestibular lesions. Spontaneous recovery, plasticity of CNS or the substitution of visual and somatosensory cues for the lost vestibular function.

The exercises commonly used in vestibular rehabilitation program are based on vestibular adaptation as well as facilitation of the use of visual and somatosensory cues for balance ***(Herdman, 1998).***

The best stimulus to improve gaze stability is the movement of the head while patient is trying to keep image in focus. This creates an error signal which the brain attempts to minimize by increasing the gain of the vestibuloocular reflex (VOR).

Movement of the visual world (optokinetic stimuli) while head is still can increase the gain of the vestibular system, known as optokinetic stimulation exercises.

However, Application of these specific exercises depends upon proper evaluation of the patients as regards assessment the degree of deficit, its location either in the peripheral vestibular

structure or central vestibular pathways. Is it unilateral or bilateral lesion? Sensory evaluation should include visual and proprioceptive abilities. Gait ambulation with head movement, motor skills and integrity of the cerebellum are critical to the successful application of vestibular rehabilitation program.

Transcutaneous Electrical Nerve Stimulation (TENS):-

TENS is a method of electrical stimulation which primarily aims to provide a degree of pain relief (symptomatic) by specifically exciting sensory nerves and thereby stimulating either the pain gate mechanism and / or the opioid system.

Pain relief by means of the gate mechanism involves activation (excitation) of the A beta sensory fibers and by doing so, reduces the transmission of the noxious stimulus from the "c" fibers, through the spinal cord and hence on the higher centers. The A beta fibers appear to appreciate being stimulated at a relatively high rate (in the order of 90 -130 Hz or pps) .It is difficult to find support for the concept that there is a single frequency that works best for every patient, but this range appears to cover the majority of individuals.

An alternative approach is to stimulate the A delta fibers which respond preferentially to a much lower rate of stimulation (in the order of 2-5Hz) which will activate the opioid

mechanisms, and provide pain relief by causing the release of and endogenous opiate (encephalin) in the spinal cord which will reduce the activation of the anxious sensory pathways.

A third possibility is to stimulate both nerve types at the same time by employing a burst mode stimulation .In this instance , the higher frequency stimulation output (typically at about 100 Hz) is interrupted (or burst) at the rate of about 2 -3 bursts per second . When the machine is "on", it will deliver pulses at the 100 Hz rate, thereby activating the A beta fibers and the pain gate mechanism, but by virtue of the rate of the burst, each burst will produce excitation in the A delta fibers, therefore stimulating the opioid mechanisms. For some patients this is by far the most effective approach to pain relief.

However TENS is recently introduced in vestibular rehabilitation therapy .in order to improve unilateral visual neglect (UVN) based on the somatosensory stimulation which seems a good tool for modulating the compromised neural systems implicated in postural instability. Applying TENS at the neck level showed spectacular neglect - related effect on postural stability. This was explained by strong evidence about the powerful effect of the neck muscles stimulation on the body posture ***(Kavounoudias et al 1999).***

More recent study revealed that TENS effect enhances somatosensory functioning visuospatial abilities and postural control in neglect ***(VanDijk ct al, 2002).***

Aim of the work:-

To examine the effectiveness of TENS on rehabilitation of patients with peripheral vestibular disorders.

Materials and Method:-

Subjects:- This study will include 30 individuals, with peripheral vestibular lesion. Diagnosed using VNG and VEMPs. All subjects will be subjected to:-

- Full history taking and otoscopic examination.
- VNG and VEMPs (Tests to localize site of the lesion).
- Daily activity scale (D.A.S) and Dynamic visual acuity (D.V.A) vertical and horizontal to measure visual impact.
- Vestibular rehabilitation therapy: -

Patients will be randomly divided into two equal groups; Group **I** will receive vestibuloocular reflex (VOR) X1 rehabilitation protocol at horizontal and vertical planes. This will be home based once per week for one month.

Group **11** will receive stimulation of the neck muscles through TENS. (2 sessions per week for one month).

- Follow up after one month by daily activity scale and Dynamic visual acuity

Equipment:-

1- Computerized Four Channel **Videonystagmography** (VNG) Micromedical Tech. Meta 4 software version 4.5.

2- Computerized Four - channel Evoked System Biologic model Navigator to conduct vestibular evoked myogenic potentials (VEMPs).

3- TENS model CE 0434.

4- Snellen Chart

Results

Discussion

Conclusions

Recommendations

Summary

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BPPV	Benign paroxysmal positional vertigo
CDP	Computerized Dynamic Posturogrphy
CNS	Central nervous system
COG	Centre of gravity
Contra-MVN	Contralesional medial vestibularnucleus
COR	Cervical-ocular reflex
DAS	Daily activity scale
DVA h, v	Dynamic Visual Activity horizontal and vertical
ES	Electrical stimulation
ENG / VNG	Electro / video nystagmography
GABA	Gama amino buteric acid
GluR delta-2	Glutamate receptor
Ipsi-MVN	Ipsilateral medial vestibular nucleus
Log MAR	Log Mean angle Resolvable
LTD	Long term depression
MDD	Mal de Debarquement
NMDA	N-methyl-D-aspartate receptor
NO	Nitric oxide
PAG	Periaqueductal grey
PKC	Beta protein kinase C
PONV	Post-operative nausea and vomiting
PP2A	Protein phosphatase 2A
p.p.s.	Pulses per second
PVD	Peripheral vestibular disorder
r-VOR	Rotational vestibuloocular reflex
SCC	Semicircular canal
SCM	Sternocleidomastoid muscles
SOT	Sensory organization test
TENS	Transcutaneous electrical nerve stimulation
t-VOR	Translational vestibuloocular reflex
µs	Micro second
UPVD	Unilateral peripheral vestibular dysfunction
VCR	Vestibulo-collic Reflexes
VEMP	Vestibular evoked myogenic potentials
VOR	Vestibulo-ocular reflex
VRT	Vestibular rehabilitation therapy
VSR	Vestibulo- -spinal reflex
VVOR	Visual vestibular ocular reflex

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