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RESEARCH ARTICLE

IDENTIFICATION AND MANAGEMENT OF NEUROPATHIC PAIN AS A PHYSICAL STRESS

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Abstract:

Neuropathic pain is a condition that a sufferer can develop with progressing peripheral or diabetic neuropathies. The pain with all its related ischemic, inflammatory and pathophysiological mechanisms is also associated with psychological considerations as the developed stress condition leads to exhaustion, anxiety, painful feelings, irritability etc. We propose that the evaluation of stress and relieve in pain symptoms through management by Transcutaneous Electrical Nerve Stimulation (TENS) can be effective in reducing physical strain in these patients. Sadaf Stress Scale and serum cortisol levels were the key investigations were mainly compared. The study concluded that a neuro-endocrine pathway to neurovascular damages and altered nerve reactivity that is linked with existence of chronic pain as a continuous physical stress that leads to pain worsening as a physiological response to stress. However the electrophysiological and neuropsychological lessening of pain can be achieved by TENS that needs to be evaluated further.

Key Words: Transcutaneous Electrical Nerve Stimulation (TENS), Neuropathy, Pain, Physical Stress, Sadaf Stress Scale, Cortisol.

Introduction

The pain intensity has an impact on the quality of life in subjects suffering from chronic pain ⁽¹⁾. The factors like irritation, anxiety, mood fluctuations, suicidal thoughts, hopelessness, sadness, helplessness and frustration are more frequently reported in these subjects in comparison with normal subjects with acute pain ^(1&2). The depressive symptoms and anxiety were investigated by using by numeric pain rating scale and Sadaf Stress Scale(SSS)⁽²⁾. Patients of diagnosed neuropathy always been diagnosed on the basis of suffering from diabetic & peripheral neuropathic pain ⁽³⁾. The pain intensity varies in patients with diabetic and non diabetic neuropathy related pain along with the psychological symptoms depending on the duration of developing and experiencing pain. The effects sometimes also related with hospital anxiety as patients were feeling annoyed of visiting doctor, taking medicine or any kind of therapy. However the subjects underwent physical exercise or electro simulation therapy reported much decline in pain intensity ^(4 &5) and improved psychological health by reporting relieve and relaxation with much ease in doing daily chores. Pain is proved at many levels as a psychological experience with both physiological and pathophysiological discomforts and mechanisms ⁽⁶⁾. It is considered and studied as a known and common form of human suffering and that can cause contribute to dramatic reductions in the quality and progress of life. It is virtually inevitable and a relatively frequent source of distress from birth to old age. Episodes of pain can vary in magnitude from events that are mundane, but common place, to crises that are excruciating, sometimes intractable, and not so common, but still not rare ^(6 &7). The costs of pain in human suffering and economic resources are extraordinary. It is the most common reason for seeking medical care, and it has been estimated that approximately 80% of physician office visits involve a pain component ^(7 & 8) (The distinction between pain and nociception provides the basis for focusing on pain as a psychological phenomenon. Nociception refers to the neurophysiologic processing of events that stimulate nociceptors and are capable of being experienced as pain ⁽⁸⁾. Instigation of the nociceptive system and brain processing constitute the biological substrates of the experience. But pain must be appreciated as a psychological phenomenon, rather than a purely physiological phenomenon ⁽⁹⁾. Specifically, it represents a perceptual process associated with conscious awareness, selective abstraction, ascribed meaning, appraisal, and learning ⁽⁸⁾. Emotional and motivational states are central to understanding its nature ^(9 & 10). Pain

requires central integration and modulation of a number of afferent and central and efferent processes. This formulation acknowledges the importance of various levels of analysis, as the basis of pain mechanism and behaviors must integrate psychological and social sciences, as well as the humanities, because pain cannot be understood solely at the level of vascular pathways, neuronal firing, and brain circuitry. Many of the serious problems in understanding and controlling pain must be understood at the psychological and social level of investigation as prevention options, complaints, clinical basis, degree of tissue damage, behaviors related to pain. Moreover on psychological account there is central role of assessment and management of pain. Usually it is adapted to consider pain as a merely sensory event according to which it is assumed that any injury does not simply produce pain; it also disrupt the brain's homeostatic regulation systems, thereby producing "stress" and initiating complex programs to reinstate homeostasis. By recognizing the role of the stress system in pain processes, we discover that the scope of the puzzle of pain is vastly expanded and new pieces of the puzzle provide valuable clues in our quest to understand chronic pain^(8 & 9). Research in stress and biological sense of physical injury with related pathologies, and also recognized the importance of psychological stresses⁽¹¹⁾. The Hypothalamic-Pituitary-Adrenal axis (HPA) and the autonomic nervous system are activated in response to stressful stimuli. Interestingly, it appears that healthy individuals react differentially to stressful stimuli, such as psychological stress and physical stress. Diurnal cortisol secretion levels in the human body while experiencing pain is quantifiable as measured by subjective reporting. Pain elevates the cortisol and disturbs the cortisol hormone secretion more in alignment with the natural 24-hour circadian rhythm profile^(11, 12 & 13). Reporting indicates that many relaxation techniques tried on human body improves the condition and reduces pain and stress. repeated measurement of free cortisol in response to physical stress should be considered a possible biological correlate of chronic physical stress. The evidence for physical stress as a cause for range of symptoms in pain has been growing and factors like anxiety, social isolation, stressful life events and lack of control over work accumulate during life and increase the risk of poor mental health ultimately affect the health. The evidence seems to be strongest for exhaustion, altered cardiovascular parameters and irritability⁽¹⁾. Currently, the best way to biologically measure the stress-response is to assess the activity of the HPA-axis through levels of cortisol^(11 & 12). Measuring cortisol concentrations is the most extensively used method of assessing stress. The main purpose of this study was to analyze Pain behaviors that vary widely among individuals and describing, as pain is more a private and personal behavior or experience and to identify pain as a major stress to cause physical stress, severity of physical stress evaluation by diagnostic screening exclusive tool in Pakistan (SSS)⁽²⁾ and To compare the different types of symptoms, intensity and stress scores with cortisol levels⁽¹⁾.

Materials and Methods

A cross sectional study was carried out at the department of physiology, university of Karachi and civil hospital Karachi from 2010 to 2014. Total 288 participants were involved in this study. All the samples were collected personally by non-probability sampling technique after having fully informed consent from the patients and the hospital. Base line history from all subject were collected through a questionnaire, which included question mainly on current health of the individual & complete history. The samples have been collected from two different types of patient's i.e. diabetic neuropathy & peripheral neuropathy. Location of pain, intensity of pain was determined by using Numeric Pain rating scale (Hartrick et al.,2003). Pain was measured on an 11-point numeric pain rating scale. (VAS; scale range: 0, no pain; 10, worse possible pain) The depressive symptoms and anxiety were investigated by using Sadaf Stress Scale (SSS)⁽²⁾ & Samples were collected from all the subjects for the study of Cortisol. The data were analyzed in statistical programmed SPSS version 16.0. Despite of medications, neuropathic patients were also prescribed to TENS Therapy as an effective way to relieve pain. A transcutaneous electrical nerve stimulation (TENS) unit consists of 1 or more electrical-signal generators, a battery, and a set of electrodes. The settings for the stimulus parameters used clinically are the following:

Amplitude	Current at a comfortable, low intensity level, just above threshold
Pulse width (duration)	120-160µsec (vary)
Pulse rate (frequency)	4-6 Hz (vary)

INCLUSION CRITERIA

- Only diagnosed cases of peripheral & diabetic neuropathy were included.
- Both gender were included

EXCLUSION CRITERIA

- Subjects having any other disease except peripheral & diabetic neuropathy were excluded.

Results

Comparison of pain scores among Diabetic Neuropathy & Peripheral Neuropathy.

The results of pain score of Diabetic neuropathy when compared with the scores of Peripheral Neuropathy by independent sample t-test to compare the means of all above parameters, p-value <0.05 considered as statistically significant. gives the mean value of pain score of Diabetic neuropathy, it was found 3.52 on average with an standard deviation of 0.897, while in the scores of Peripheral Neuropathy the mean was 6.13 with an standard deviation of 1.60, the significant p-value <0.01 was obtained using the independent sample t-test shows the significant differences in the pain score of Diabetic neuropathy and scores of Peripheral Neuropathy that indicate the numbness and loss of pain sensation in diabetic patients though there is much tissue damage.

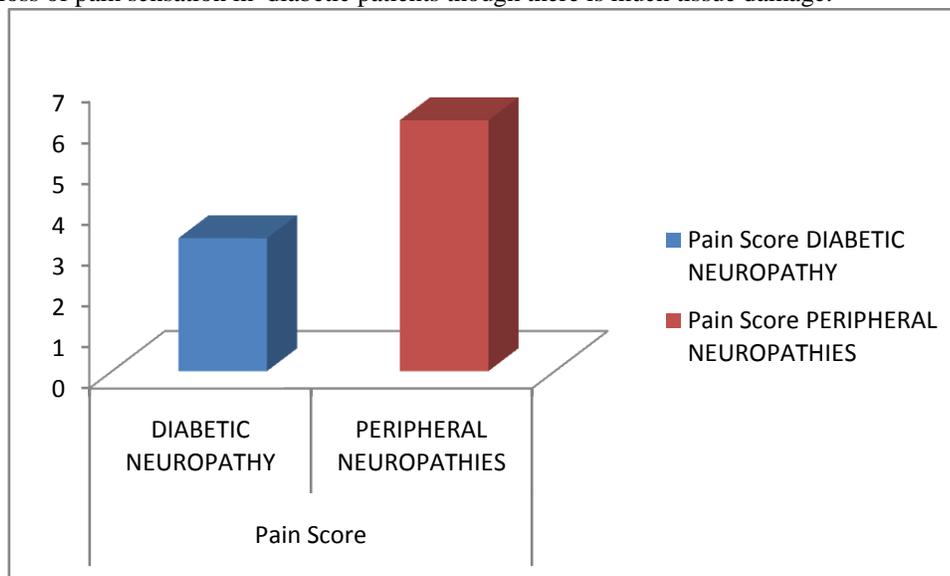


Fig: 1. Horizontal bar diagram displayed the mean of pain score between Diabetic Neuropathy & Peripheral Neuropathy, respectively, it can be seen that, pain score have lesser mean values in Diabetic Neuropathy as compared to Peripheral Neuropathy.

Comparison of physical stress Levels between Peripheral Neuropathies & Diabetic Neuropathy :

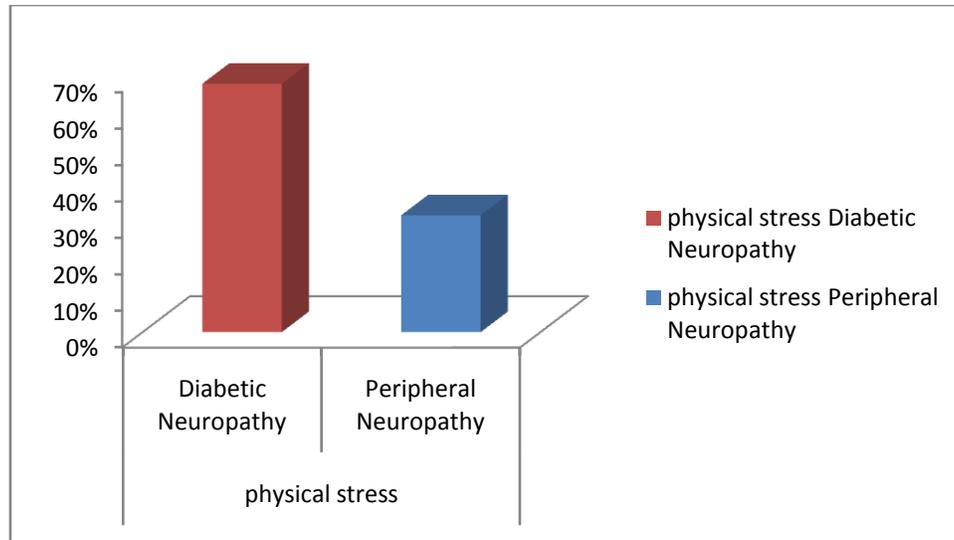


Fig: 2. Horizontal bar diagram displayed the mean of physical stress Levels between Peripheral Neuropathies & Diabetic Neuropathy respectively, it can be seen that, all Peripheral Neuropathies have lesser mean values as compared to Diabetic Neuropathy.

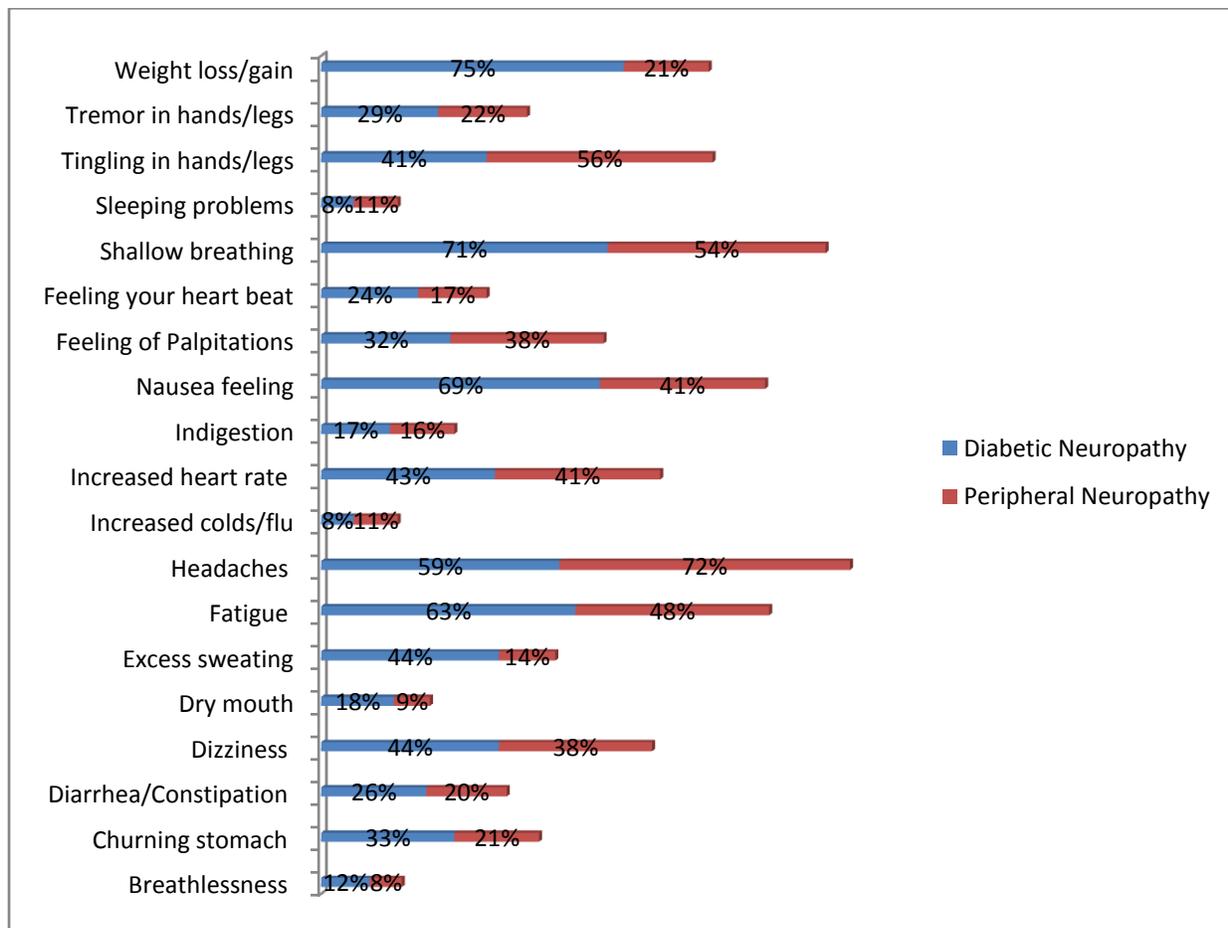


Fig: 3. Vertical bar diagram in displayed the mean % of physical stress symptoms between Peripheral Neuropathies & Diabetic Neuropathy respectively, it can be seen that mostly PERIPHERAL NEUROPATHIES have lesser mean values as compared to DIABETIC Neuropathy.

Comparison of Cortisol Levels After Pre & Post Subjects with TENS

The results of Cortisol Levels of pre TENS compared with the post TENS with used Paired sample t-test to compare the means of all above parameters, p-value <0.05 considered as statistically significant. it gives the mean value of Cortisol Levels of pre TENS, it was found 42.15 on average with an standard deviation of 28.7, while in the scores of post TENS the mean was 40.25 with an standard deviation of 28.093, the significant p-value <0.01 was obtained using the Paired sample t-test shows the significant differences in the Cortisol Levels of pre TENS and scores of post TENS.

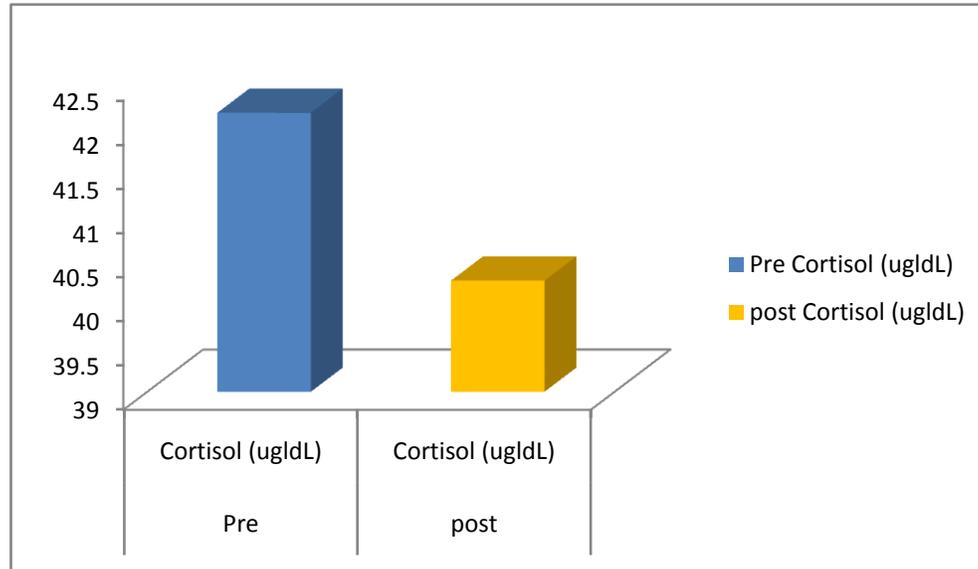


Fig. 4: Horizontal bar diagram displayed the mean of cortisol between Pre-TENS Patients & Post-TENS Patients, respectively, it can be seen that, cortisol have lesser mean values in Post-TENS Patients as compared to Pre-TENS Patients.

Comparison of Moderate, High & Severe Cortisol Levels after Pre & Post Subjects with TENS

The results of Pre Tens Cortisol Levels of Moderate, High & Severe compared with the post TENS. We used Paired sample t-test to compare the means of all above parameters, p-value <0.05 considered as statistically significant, gives the mean value of Moderate Cortisol Levels of pre TENS, it was found 22.395 on average with an standard deviation of 4.04, while in the scores of post TENS the mean was 20.870 with an standard deviation of 3.961, the p-value <0.01 was obtained using the Paired sample t-test shows the significant differences in the Moderate Cortisol Levels of pre TENS and scores of post TENS. Further gives the mean value of High Cortisol Levels of pre TENS, it was found 57.73 on average with an standard deviation of 9.866, while in the scores of post TENS the mean was 55.692 with an standard deviation of 9.7692, the significant p-value <0.01 was obtained using the Paired sample t-test shows the significant differences in the High Cortisol Levels of pre TENS and scores of post TENS. The mean value of Severe Cortisol Levels of pre TENS, it was found 110.125 on average with an standard deviation of 11.90, while in the scores of post TENS the mean was 106.425 with an standard deviation of 12.033, the significant p-value <0.01 was obtained using the Paired sample t-test shows the significant differences in the Severe Cortisol Levels of pre TENS and scores of post TENS.

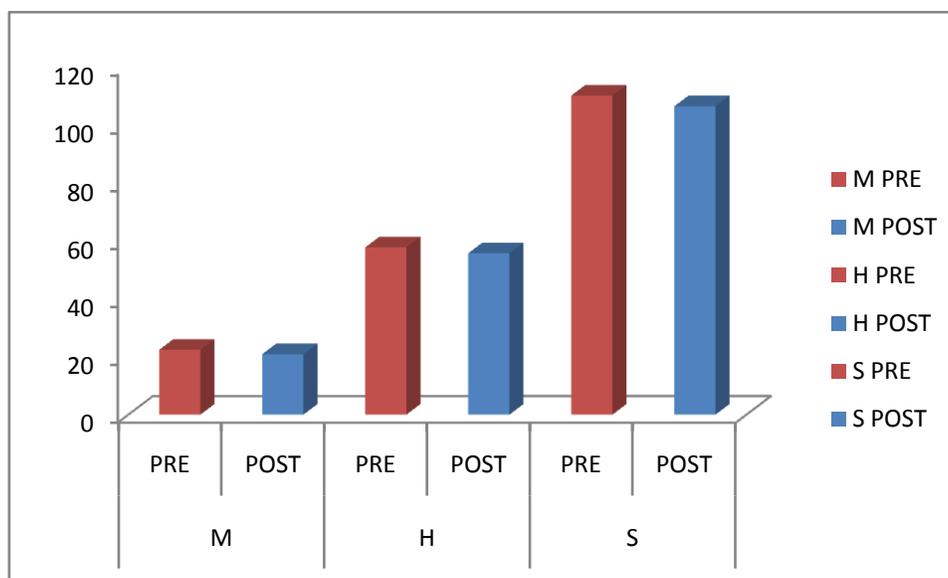


Fig: 5: Horizontal bar diagram displayed the mean of Pre Tens Cortisol Levels of Moderate(M), High(H) & Severe(S) compared with the post TENS, respectively, it can be seen that, all parameters have lesser mean values in Post-TENS as compared to Pre-TENS.

Discussion

Our results of pain scores subjected to before or after TENS supported the classic view of neuropathic pain(5) that without being treated it is a debilitate disorder characterize by episodes of severe pain or may be low and high pain intensities experiences and production of sensitive trigger zones on skin (14). It is associated with mechanical deformation of the nerve root that may cause demyelination and associated pathologies from an anomalous blood vessel worsening the symptoms (15). The types of classical neuropathic pain also have diabetic neuropathic pain due to torn out long axons of peripheral nerves with patients suffering with burning and numbness as the pain sensing ability reduces with time (16,3). Our results also demonstrated that The clinical manifestations vary with the type and intensity of pain and its mechanisms. These differences also suggest the opted suitable management to bring best responses for progressive worsening conditions in painful diabetic neuropathy. However the dissimilarity of neuropathic pain characteristics and its improvement in diabetic and peripheral conditions has efficacy in the clinical setting, a need to study of neuropathic pain origination and conditions (17). Typically sufferers of chronic pain rely on identification of symptoms appeared by pain producing mechanisms and the understanding of classified characteristics reported by patient that exist in a chronic pattern with disturbed physiological functions and psychological twinge (7). The direct or indirect changes in electrophysiological and anatomical aspects of nerve are helpful in characterizing pain symptoms along with the related pathologies (9). With the help of our findings we propose that neuropathic pain symptoms and mechanisms that apply to all body parts are different with respect to categorization tissue injury pathologies along with nervous pain, both of which include a variety of general mechanisms. Usually the complain of neuropathic pain is spontaneous without any usual or typical stimulus or trigger with continuous episodic and sporadic occurrence with clinical aspects of neuropathic pain should only be made when the distribution of pain and the associated sensory abnormalities jointly, and in a clinical context, point to a neurological condition (8). The present study also indicates an association between a inflammation markers and the development of peripheral diabetic neuropathic pain, to the best of our knowledge, there are no previous studies in human diabetes that demonstrated an association between diabetic neuropathy and systemic inflammation in human diabetes along comparison of it with pain intensity. One additional limitation is that painful symptoms were evaluated employing only one technique, the NSS, and not using additional methods such as the visual analog scale. In our study the physical stress -related hypothalamic - pituitary adrenal (HPA) –axis was highlighted and significant results were notexs in patients with neuropathic. As per SSS they were analyzed for physical stress symptoms (Table) and found moderate to severe level stress in these pain bearing subjects. Though their pain scores were low when look into account with their diabetic history. The serum cortisol as a biomarker for stress was also measured and compared in the pre and post TENS condition. We investigated the association between chronic physical stress and cortisol changes, it was hypothesized that chronically stressed subjects would show a more

enhanced and prolonged increase of cortisol level, their stress found to be moderate to severe with elevated cortisol levels and showed that chronically stressed pre TENS subjects had a significantly larger increase in cortisol compared to much relieved post TENS subjects that could be an indication of TENS reducing physical stress by acting via HPA axis⁽⁸⁾. It is now established that statement between the brain, spinal cord, nerves and the immune system all are functionally dependent on each other and in chronic physical stress condition like neuropathic pain the altered immune responses can lead to endocrine and nervous system serious altered reactions^(11, 12 & 13). The neuro-endocrinological responses to inflammation⁽¹⁸⁾ are also associated with presence of chronic stressor like pain and the vicious cycle of pain worsening becomes body's physiological response to stress. Moreover the electrophysiological and neuropsychological relieve influenced by TENS can be used to evaluate further aspects⁽⁴⁾.

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