

Music Modulated TENS Therapy

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Abstract— Often, for alleviating severe pain, strong painkiller medications are administered which leads to side effects on a long term basis. In case postoperative care this prolongs surgical recovery time in turn increased hospitalization costs. One cannot do away without using pain medications but finding an alternative way to lessen the dosage and therefore lessen the side effects is highly sought after area of research over the years. Alternative pain treatment methods, such as music therapy, TENS (Transcutaneous Electrical Nerve Stimulus) can be envisaged as an aid to some of the problems posed by pain medications. Implementing music therapy along with TENS could possibly reduce the health risk of these pain drugs and medical costs. In this paper the basic science of TENS, the results of various experiments conducted for testing effectiveness of TENS and combined effect of TENS and music that could be achieved in alleviating pain is discussed.

The effect of TENS on parasite killing on vegetables increasing their shelf life, accelerating relaxation in humans is highlighted in this paper.

Keywords— *Post operative care, TENS (Transcutaneous Electrical Nerve Stimulus), Music therapy, Alleviating pain.*

I. INTRODUCTION

The Biology of Pain.

In humans there are commonly three types of nerves; motor nerves which are the largest and go to the muscles, sensory nerves are a little smaller and allow the person to feel the happenings of the skin, and pain nerves, the smallest, which transmit pain impulses. In case of any tissue damage or pain, Nociceptors are the nerve cells which get activated and electrical signals are sent to spinal cord. The neurotransmitters in spinal cord forward this sensation to the brain. The brain then responds by analyzing it and sending natural painkillers like endorphins, endogenous opioids or norepinephrine to numb the sensation.[1]

II. THEORIES

There are two theories behind how TENS units work.

A. Gate Theory:

Pain impulses progress through the small nociceptive fibers with little or no myelination (A-delta and C fibers), whereas the current passed through TENS electrode activates large, highly myelinated fibers (afferent A- beta fibers). When these two impulses arrive at the same pathway into the brain, the larger nerve impulse (thicker A-delta fibers with slight myelination) supersedes the smaller nerve impulse due to it's more conducive to transmit faster. By doing so pain impulse cannot reach brain, as electrical stimulation decreases the sensation of pain by increasing the activation of A-beta fibers and therefore 'closing the gate' of pain for transmission to spinal cord(Fig.1). Although biologically the activation of large

B. Endorphin Theory:

Also known as the opiate-mediated theory is based on the presence of natural opiates in the body. They are produced in the spinal cord and pituitary gland as enkephalins[11] and beta-endorphins, respectively and act as the body's own natural pain relievers. These help in decreasing the sensation of pain and, in turn mimic the action of narcotic drugs. This theory is attained when low-frequency (approximately 1-10 Hz or if a burst mode) TENS is used as it activates mu -opioid receptors both in the spinal cord and supraspinally (in the medulla) . The endogenous opiates produced interact with specific receptor sights in the central and peripheral nervous systems, thereby blocking the perception of pain. [3]

nerves doesn't occur naturally.

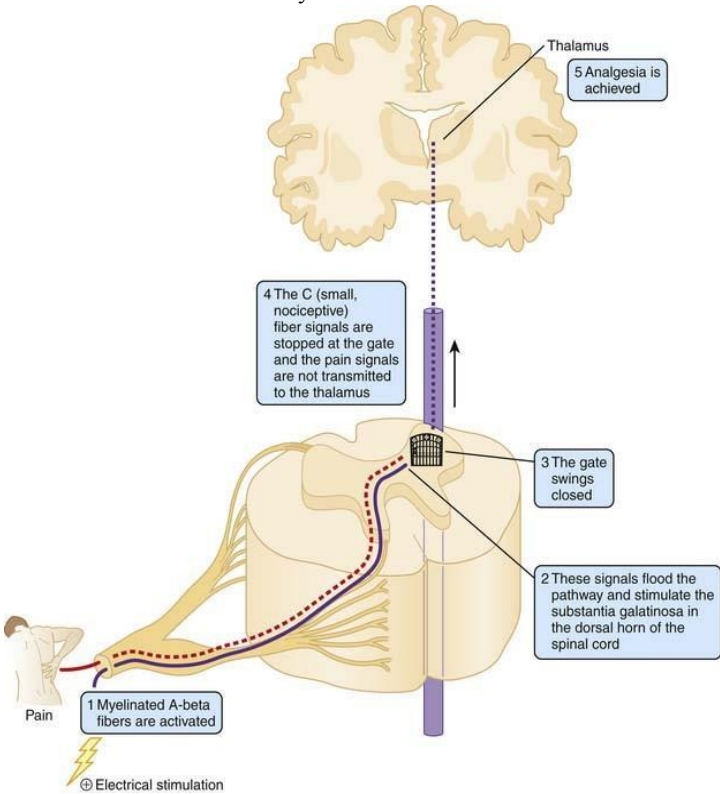


Fig 1. Simplistic view of the gate control theory. Pain signals are blocked at the spinal cord level before they can be transmitted to the brain. [2]

III. SYSTEM BLOCK DIAGRAM

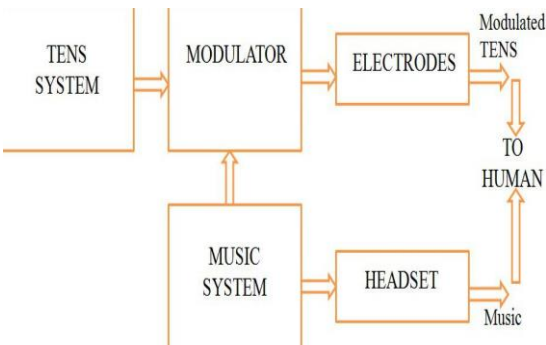


Fig 2. Block diagram of proposed system

The normal TENS pulse is modulated using the music as selected by the physiotherapist/nurse, accordingly the output of modulator shall be modulated TENS pulse which is administered via electrodes to the person. The music used for modulation is also given via the headset to the person for greater extent of relaxation.

IV. SOFTWARE SIMULATION OF TENS SYSTEM

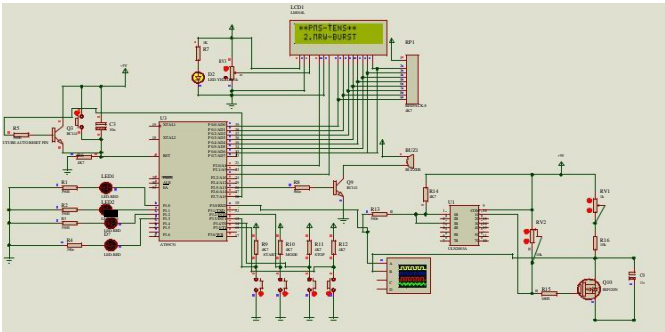


Fig 3. Software simulation of proposed system[10]

V. TENS ON VEGETABLES

An experimentation to check the effect of TENS on fruits & vegetables was carried out. Here two identical potatoes were used. Initially both potatoes A & B were cut, to make a site for bacteria's to build in, with application of TENS on regular basis only on potato B. It was observed that blackening of Potato B was comparatively less compared to that of Potato A. Before making any concrete conclusion on TENS use for killing of parasite/ bacteria [4], it is essential to carry out this in multiple samples.

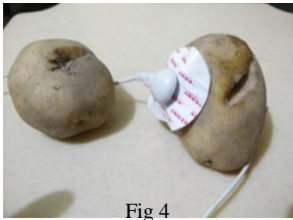


Fig 4. Potato A towards left and TENS given to potato B on right side.
Fig 5. Potato B is less blackened and is on left side whereas potato A towards right.



VI. TENS ON HUMANS

The experiment conducted was the relaxation period required for humans after physical activities such as running in the stairs without administrating TENS to the subject and after administrating TENS was analyzed based on blood pressure and pulse rate, the results observed are tabulated below.

TABLE I. READINGS TAKEN OF 10 HEALTHY PEOPLE MEASURING BLOOD PRESSURE (BP) IN UNITS OF SYSTOLE AND DIASTOLE (SYS, DIA) AND

PULSE RATE (PR) IN UNITS OF HEART PER MINUTE (BPM) WITH AND WITHOUT TENS

Trail	After walking stairs (BP)			After 10 mins interval (BP)			After TENS therapy (BP)		
			(PR)			(PR)			(PR)
	Sys	dia	bpm	sys	dia	bpm	sys	dia	bpm
1.	136	88	82	131	85	80	125	80	78
2.	123	77	114	118	75	100	112	81	83
3.	128	90	84	121	84	75	118	79	73
4.	130	92	100	126	90	97	125	89	80
5.	133	100	102	125	96	94	123	92	84
6.	140	108	106	128	100	90	124	100	88
7.	138	94	106	125	88	87	130	90	74
8.	135	92	108	127	90	85	122	88	76
9.	138	96	105	125	90	90	123	89	79
10.	145	99	111	130	86	85	128	84	75

VII. RESULTS

From the experiments performed as above we come to few observations which helps to analyze more about the use and effectiveness of tens not only humans but on vegetables and fruits as well.

1 .It was observed that TENS helps increase the shelf life of vegetables and fruits, though to a small extent.

2. TENS on humans has helped to bring down blood pressure and pulse rate to standard normal values. On the basis of values as mentioned above there is a 3 min difference in bringing down the physiological parameters to normal values.

VIII. MUSIC THERAPY

The traditional classical music of India, offers a soothing effect to the body, lowers mental tensions and has been recommended for patients suffering from heart diseases, high blood pressure, diabetes etc. The empirical studies result on therapeutic evaluation of the classical ragas is mentioned below: [6] [9]

Raga Bhairavi has been found to uproot some of the sinus and chest related problems like asthma, chronic cold, cough, tuberculosis.

Raga Asavari is efficacious in eliminating the impurities of blood and related diseases.

Raga Malhar pacifies anger, excessive mental excitement and instability.

Raga Surat and Raga Jaijaivanti have also been found successful in curing mental disorders and calming the mind.

Raga Hindola helps enhancing concentration and sharpening the memory.

A research study conducted at the Berlin University indicated that the bacteria and germs in the surrounding could be destroyed by the vibrations produced by the bugle sound. More specifically, it was

found that if the *Shankha* is played by infusing (through the mouth) twenty-seven cubic feet of air per second, within a few minutes the bacteria in a surrounding area of two thousand two hundred square feet shall be killed.[9] The contribution of the positive emotional property of music to music-induced analgesia has been put into practice like in case of postoperative pain or in chronic pain.[7] Once the music is combined with brain wave signals, it stimulates the alpha waves of brain which have been determined as a stimulator for release of endorphin and creates a relaxation state proving to be an aid for pain relief. Consequently reducing heart rate, blood pressure, body temperature and respiration rate and this is a distraction reducing the pain perception and reducing especially the nausea due to chemotherapy. The effectiveness of TENS with music therapy thus cannot be denied completely.

IX. MUSIC WITH TENS-BLOCK DIAGRAM

The simulation of a simple IC555 based mono-stable multi-vibrator for conversion of music to generate TENS –PWM mode is shown in fig6. The output is controlled by the voltage amplitude at pin no 5 (Control pin). A better result can be obtained by using Graphic Equalizer (MSGEQ07) in order to limit the highly varying frequency music to a limited frequency range of TENS.

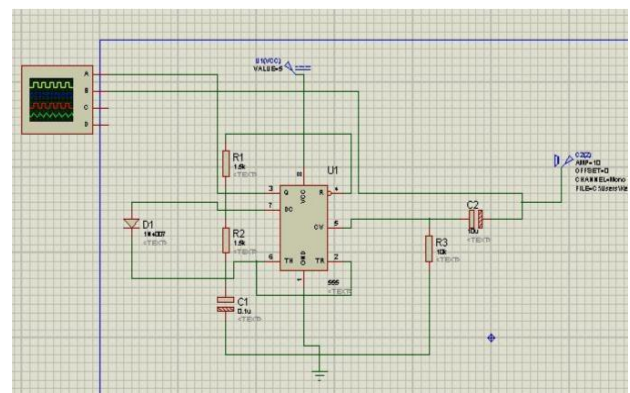


Fig6.simulation for conversion of music to TENS waveforms

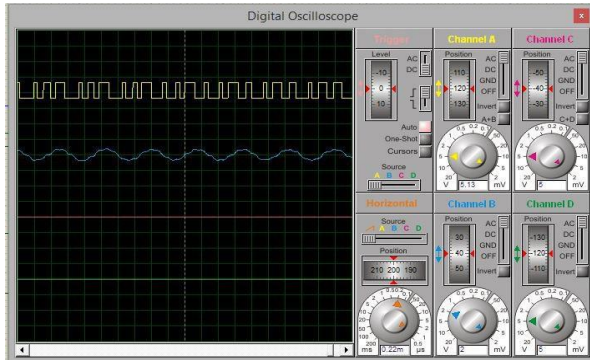


Fig.7.Output for fig.6 Simulation

X. CONCLUSION

Music which shall be prescribed by the physiotherapist is to be used as modulating signal and TENS unit pulse as carrier signal, both when given to custom made modulator circuit the pulse obtained shall be music modulated TENS. The same music shall be given to the patients via headphones. It is expected that the combination of both therapies as one should enhance the relaxation as well as promote pain relief. With reference to the results above, it could be said that, TENS is effective in killing of the bacteria and therefore can be used for wound or skin healing. TENS therapy can be enhanced by using music and the generation of fundamental PWM pulse can be obtained by the simple circuitry as mentioned above.

XI. REFERENCES

- [1] Mark JohnsonMI(1998)Transcutaneous electrical nerve simulation(TENS).17:261
- [2] Gerta Vrbová, Olga Hudlicka and Kristin Schaefer Centofanti, "Application of Muscle/Nerve Stimulation in Health and Disease" Springer Science & Business Media, 19-Apr-2008
- [3] Madhuri Sharma, Rajnee, and Kamlesh Chandra Mathur "Affects of Music Therapy On Clinical And Biochemical Parameters Of Metabolic Syndrome" J Bangladesh Soc Physiol, 2011 December ; 6(2): 108-115
- [4] Carrie Sussman, Barbara M. Bates-Jensen "Wound Care: A Collaborative Practice Manual"Lippincott Williams & Wilkins, 2007
- [5] Lazarou L, Kitsios A, Lazarou I, Sikaras E, Trampas A "Effects of intensity of Transcutaneous Electrical Nerve Stimulation (TENS) on pressure pain threshold and blood pressure in healthy humans: A randomized, double-blind, placebo-controlled trial." Clin J Pain. 2009 Nov-Dec;25(9):773-80. doi: 10.1097/AJP.0b013e3181a7ece3.
- [6] Srivastava R. A bit of raga may cure your ailment – Times of India. Sep 6, 2001
- [7] Chelsea Ducille "Musical Healing: Music Therapy as a Supplement or Replacement to Postoperative Pain Medication" Academic Writing (Spring 2012) Music as Medicine Professor Cary Moskovit
- [8] The brain from top to bottom
http://thebrain.mcgill.ca/flash/d/d_03/d_03_cl/d_03_cl_dow/d_03_cl_dou.html#
- [9] OEOM Shanti Music therapy http://oeom.com/?page_id=173
- [10] AT89S52 Data sheet www.atmel.com/images/doc0313.pdf
- [11] <https://en.wikipedia.org/wiki/Enkephalin>

