RESEARCH PAPER

Comparison of analgesic effect of interferential therapy and transcutaneous electrical nerve stimulation on pressure pain threshold on young healthy individuals

Vipra P. Dalal, Megha S. Sheth, Neeta J. Vyas

SBB College of Physiotherapy, V S hospital, Ahmedabad, India

Correspondence address: B-13, Mangaljyot Society, College Road, Santrampur, Mahisagar-389260, Gujarat, India. E-mail: vipradalal292@gmail.com

DOI: 10.5455/jcer.201425

ABSTRACT

Objectives: The purpose of this study is to compare the analgesic effect of interferential therapy (IFT) and transcutaneous electrical nerve stimulation (TENS) on pain pressure threshold (PPT) in young healthy subjects. **Materials and Methods:** A comparative, crossover study involving 30 volunteers was conducted at Physiotherapy College. Inclusion criteria were healthy subjects, aged 18-25 years, taking no analgesic medication. Exclusion criteria were any painful musculoskeletal conditions, any contraindications to electrotherapy. IFT (Base-100 H_Z, Sweep-0 H_Z, 4PV90) and TENS (Frequency-100 H_Z, Pulse duration-50microsecond) were given to the subjects using four electrodes placed covering the L1 to S2 areas for 15 minutes. PPT was taken from right erector spine muscle targeted as the central area of stimulation via mechanical algometer. **Results:** Data of 20 subjects were analyzed using SPSS 16 version. Paired t-test applied to see difference within the group and unpaired t-test applied to see difference between the groups. Mean difference is PPT scores in kgf were IFT (baseline=2.77±0.43, 15min=3.53±0.43, 60min=3.29±042), TENS (baseline=2.72±0.43.15min=3.53±0.41, 60min=2.96±0.42). Difference between baseline and 15min (IFT=0.76±0.27, TENS=0.62±0.28, p=0.13). Difference between baseline and 60min (IFT=0.51±0.22, TENS=0.24±0.19, p<0.05). There was no significant difference found between IFT and TENS PPT score after 15 min. But there is significant difference found IFT and TENS PPT score after 60 min. **Conclusion:** Both TENS and IFT increased the pressure pain threshold to a similar extent immediately after stimulation. However, the post- stimulation effect of interferential current lasted longer than that of transcutaneous electrical nerve stimulation at 60 minute.

Key words: Analgesic effect, interferential therapy, pressure pain threshold, transcutaneous electrical nerve stimulation

INTRODUCTION

Interferential current therapy (IFC, IFT) is the transcutaneous application of alternating medium-frequency electrical current for therapeutic purpose.[1] It is widely used in physical therapy clinics to provide pain relief in variety of conditions and patients populations.[2,3] IFCs deliver currents to deep tissues through the use of kilohertz carrier frequency pulses or sinusoidal currents to overcome the impedance offered by the skin. Two currents can be delivered out of phase because very high frequency currents are not uncomfortable for subjects; these currents interfere with each other within tissues at the point where the currents cross.[4,5]

TENS interventions tend to be described according to the technical characteristics of TENS as 'high frequency, low intensity' (conventional TENS) or 'low frequency, high intensity' (acupuncture-like TENS). This has resulted in unclear reporting of TENS interventions because it fails to specify the physiological intention of TENS. In this regard, the physiological intention

of conventional TENS is to selectively activate non-noxious skin afferents without simultaneously activating noxious skin afferents as this leads to segmental anti-nociception.[6]

Theoretically, high frequency (~10–250 pps), low intensity (non-painful) currents would be most efficient in selectively activating non noxious skin afferent.[5]

As described by Melzack and Wall, TENS and IFCs are forms of electro analgesia based on the gate control theory of pain perception. According to this theory, stimulation of large diameter primary sensory afferent cutaneous fibers activates inhibitory interneurons in the spinal cord dorsal horn and thus may ease the transmission of nociceptive signals from small diameter A delta and C fibers.[7]

Pressure algometry is the most common modality used to apply a uniform rate of pressure for inducing mechanical pain. Among the various exogenous experimental pain models (i.e., electrical, mechanical, chemical), the mechanical induced pain model is believed to assess deep tissue (i.e., muscle) reflecting its sensitivity to pain.[8]

Pressure pain sensitivity, evaluated using the pressure pain threshold is the most commonly used method for quantitative analysis of local muscle pain and tenderness. The assessment of pressure pain threshold has been extensively used in both clinical and experimental conditions to assess muscle pain sensitivity and to evaluate the efficacy of therapeutic interventions and pain reliving modalities in patients as well as healthy subjects.[8]

Johnson et al carried out research to see the effect of electrical stimulation on experimental cold-induced pain. Initially they did not find that 100 Hz TENS elevated experimentally induced cold pain threshold. However, the same group of researchers [9, 10] confirmed that TENS did elevate cold pain thresholds significantly in a study later.

Analgesic effect of IFT and TENS on pain pressure thresholds have been studied separately but no comparison has been done.[8, 11, 12] Thus objective of this study was the comparison of analgesic effect of IFT and TENS on pain pressure threshold in young healthy subjects.

MATERIALS AND METHODS

A comparative, crossover study including 20 individuals was conducted at the physiotherapy college in August 2013. Inclusion criteria were healthy subjects, aged 18-25 years, taking no analgesic medication. Exclusion criteria were any painful musculoskeletal condition, any contraindication to electrotherapy.

Procedure and purpose of the study were explained to the participants. Written informed consent was taken in understandable language. Subjects were divided into two groups, Group 1and Group 2. Group 1 received IFT on day 1 and TENS on day 2. Group 2 received TENS on day 1 and IFT on day 2.

PPT was measured by applying a calibrated mechanical algometer at constant rate of force of 1kg/cm^2 second. Pressure pain sensitivity was evaluated through the pressure pain threshold, or the minimum pressure that induces pain or discomfort. In this study, a mechanical algometer was used to determine the muscle pain sensitivity in the lumber area. Pressure pain threshold measurements have been shown to have good or excellent inter-rater reliability (ICC 074.-0.90). and inter –rater reliability (ICC 0.75-0.99).[13]

The algometer was applied [16] perpendicularly over right erector spinae muscle, 4 cm to the right of the spinous process of L4.

The parameters used for IFT were carrier frequency-4000 Hz, Base frequency -100 Hz, Sweep frequency -0 Hz, 4PV90 and for TENS, Frequency-100 Hz, Pulse duration-50 microseconds were used. The four electrodes were placed covering the LI to S2 areas in the back.

Intervention was given to the subjects for 15 minutes. PPT was measured immediately, after 15 min and after 60 min.

All subjects received both IFT and TENS with at least one day of rest in between.[16] Level of significance was kept at 5%.

RESULTS

All participants received both IFT and TENS. The study population had 20 participants of mean age of 22±4.26 years. Results were analyzed using SPSS version 16. t- test was used to determine if there was any significant difference between effect of IFT and TENS at 15min and at 60 min. Table 1 shows mean and SD of PPT at baseline, at 15 min, at 60 min.

Table 1: Mean ± SD of pressure pain threshold (PPT) at baseline, at 15 min, at 60 min in kgf

	Baseline PPT	PPT at 15 min	PPT at 60 min
IFT	2.77±0.43	3.53±0.43	3.29±0.42
TENS	2.72±o.43	3.53±0.41	2.96±0.42

IFT, Interferential therapy; TENS, Transcutaneous electrical nerve stimulation; kgf. kilogram force

Table 2 shows difference in PPT at 15 min-baseline, at 60 min-baseline. There was no statistically significant difference found between IFT and TENS PPT score after 15 min. But there was significant difference found IFT and TENS PPT score after 60 min.

Table 2: Difference in pressure pain threshold (PPT) at 15 min-baseline and at 60 min-baseline in kgf

Parameter	IFT	TENS	*P*-Value
15 min-baseline	0.76±0.27	0.62±0.28	0.13
60 min-baseline	0.51±0.22	0.24±0.19	<0.05

IFT, Interferential therapy; TENS, Transcutaneous electrical nerve stimulation; kgf. kilogram force

DISCUSSION

From the study, there was no statistically significant difference found between effect of analgesia by IFT and TENS on PPT score after 15 min. Thus from the study it can be said that both TENS and IFT increased the pressure pain threshold to a similar extent immediately after stimulation. But after the stimulation PPT in both groups tended to drop. However, this drop was slower in the IFC group than in the TENS group. In other words, the anti-nociceptive effects of TENS occurred mainly during stimulation, but the effect of IFC lasted longer after stimulation.

TENS and IFC are afferent stimulations that are applied to the skin; their analgesic mechanisms are similar, probably involving the gate control theory, the physiological block and the endogenous pain inhibitory system.

The gate control theory was proposed by Melzack and Wall [14] in 1965. They suggested that the substantia gelatinosa in the dorsal horn of the spinal cord acts as a gate control system. Activation of the large diameter myelinated fibers transmit touch, pressure and vibration (i.e., the Aα and Aβ fibers) is thought to facilitate the pre-synaptic inhibition of substantia gelatinosa cells on the transmission cells in the dorsal horn, thus reducing pain transmission, which may reduce the output of the transmission cells, thus reducing the Pain. Hence, there is increase in pain pressure threshold in both IFT and TENS.

The other anti-nociceptive mechanism is physiological block.[15] The C fibers are able to fire when the frequency of an electrical stimulus is below 15 Hz. When the frequency of stimulation increases, the conduction in the C fibers decreases. The application of an electrical stimulus above 50 Hz may result in a physiological block. For Aα fibres, the physiological block occurs at a higher frequency of 40 Hz. Since both TENS and IFC were applied at 100 Hz in this experiment, a physiological block may have occurred, thus increasing the pain pressure threshold.

Our results are consistent with those reported by Marchandet al.[16] They investigated the heat pain threshold on the cheek before, during and after 15 minutes of TENS treatment in healthy subjects. They demonstrated that TENS significantly increased the heat pain threshold during stimulation, compared with the baseline value. However, the threshold regressed back to the baseline level after stimulation.

Johnson and Tabasam compared the analgesic effects of IFC, TENS and placebo stimulation on cold-induced pain. No significant differences in the pain intensity or unpleasantness ratings were found among the 3 treatment groups. Their findings suggested no differences in the analgesic effects of inferential currents and TENS on cold induced pain.[17] The findings are similar to those of present study which shows no difference in effects of IFT and TENS 15 minutes after treatment.

Our results suggest that the anti-nociceptive effect produced by IFC is more prolonged than that of TENS. This may be due to the fact that IFC is a medium frequency current that exerts lower resistance to skin than TENS (a low frequency stimulation). This could be due to the stronger

penetration power of IFC. Therefore, IFC is likely to be more effective in penetrating through the skin and stimulating the deep nerve tissues underneath.[18]

The limitations of the study were this was done on healthy subjects experiencing mechanically induced pain. So it cannot be generalized to the clinical pain. Blinding was also not possible. Future research can be conducted to see the effects of IFT and TENS on pain in any clinical condition.

CONCLUSION

Both transcutaneous electrical nerve stimulation and interferential current increased the pressure pain threshold to a similar extent immediately after stimulation. However, the post- stimulation effect of interferential current was greater than that of transcutaneous electrical nerve stimulation at 60 minute.

REFERENCES

1. Low J, Reed A. Electrical stimulation of nerve and muscle.in: Low J, Reed A, editors. Electrotherapy explained. Principals and practice. 3rd ed. Oxford: Butterworth-Heinemann; 2000. p. 43-140.
2. Chipchase LS, Williams MT, Robertson VJ. A national study of the availability and use of electrophysical agents by Australian physiotherapists. Physiother Theory Pract 2009:25:279-96.
3. Poitras S, Blais R, Swaine B, Rossignol M. Management of work-related low back pain: a population-based survey of physical therapists. Phys Ther 2005;85:1168-81.
4. Hansjuergens A. Interferential current clarification. Phys Ther 1986;66:1002.
5. Johnson MI, Tabasam G. An investigation into the analgesic effects of interferential currents and transcutaneous electrical nerve stimulation on experimentally induced ischemic pain in otherwise pain-free volunteers. Phys Ther 2003;83:208-23.
6. Barlas P, Lundeberg T. Transcutaneous electrical and acupuncture. In: McMahaon SB, Koltzenburg M, editors. Melzack and Wall's textbook of pain. Philadelphia: Elsevier Churchill Livingstone; 2006. p. 583–94.
7. Chung JM. Anti-nociceptive effects of peripheral nerve stimulation. Prog Clin Biol Res 1985;176:147-61.
8. Jorge FC, Armijo-olivo S, Magee DJ, Gross DP. A preliminary investigation into the effects of active interferential current therapy and placebo on pressure pain sensitivity: a random crossover placebo controlled study. Physiotherapy 2011;97:291-301.
9. Johnson MI, Ashton CH, Bousfield DR, Thompson JW. Analgesic effects of different frequencies of transcutaneous electrical nerve stimulation on cold-induced pain in normal subjects. Pain 1989;39:231-236.
10. Johnson MI, Ashton CH, Bousfield DR, Thompson JW. Analgesic effects of different pulse patterns of transcutaneous electrical nerve stimulation on cold-induced pain in normal subjects. J Psychosom Res 1991; 35:313-321.
11. Johnson MI, Tabasam G. A double-blind placebo-controlled investigation into the analgesic effects of interferential currents and transcutaneous electrical nerve stimulation on cold induced pain in healthy subjects. Physiother Theory Pract 1999;15:217-233.
12. Chesterton LS, Barlas P, Foster NE, Lundeberg T, Wright CC, Baxter D. Sensory stimulation (TENS): effects of parameter manipulation on mechanical pain thresholds in healthy human subjects. Pain 2002;99:253-262.
13. Fuentes CJ et al. Does amplitude modulated frequency have a role in the hypoalgesic response of interferential current on pressure pain sensitivity healthy subjects? Physiotherapy 2010;96:22-29.
14. Melzack R, Wall PD. Pain mechanisms: A new theory. Science 1965;150:971-979.
15. De Domenico G. Pain relief with interferential therapy. Aust J Physiother 1982;28:14-18.
16. Sjolund B, Eriksson M, Loeser J. Transcutaneous and implanted electric stimulation of peripheral nerves. In: Bonica J, editor. The management of pain. Vol 2. Philadelphia: Lea & Febiger; 1990. p. l852-61.
17. Johnson MI, Tabasam G. A double-blind placebo-controlled investigation into the analgesic effects of interferential currents and transcutaneous electrical nerve stimulation on cold induced pain in healthy subjects. Physiother Theory Pract 1999;15:217-233.
18. Cheing GL, Hui-Chan CW. Analgesic effects of transcutaneous electrical nerve stimulation and interferential currents on heat pain in healthy subjects. J Rehabil Med 2003;35:15-19.

Cite this article as: Dalal VP, Sheth MS, Vyas NJ. Comparison of analgesic effect of interferential therapy and transcutaneous electrical nerve stimulation on pressure pain threshold on young healthy individuals. J Clin Exp Res 2014;2:129-132.

Source of Support: Nil, **Conflicts of Interest:** None declared