

# Comparative Study Between Lidocaine Topical Application And Iontophoresis On H-Reflex

Samir A. Sabbah, Ph.D.PT and Mohamed H. Elgendy, Ph.D.PT  
Basic Science Department, Faculty of Physical Therapy, Cairo University.

## ABSTRACT

**Background and purpose:** Lidocaine sodium chloride has a potent analgesic effect. Different ways have been used for lidocaine administration such as injection, topical application and iontophoresis. The purpose of this study was to compare between topical anaesthesia and iontophoresis administration on inhibition of motor neuron pool measured by H-reflex in normal subjects. **Subjects:** Twenty male subjects participated in this study. They were recruited from the students of the Faculty of Physical Therapy, Cairo University. Their age ranged from 20 to 25 years (mean=22.03 ± 1.38). **Design:** The current study was pretest, posttest research design. **Materials and Methods:** Every participant was subjected to two methods of treatment: Topical application and Iontophoresis separately. H-Reflex excitability was measured in all participants by Electromyography machine before and 10 minutes after each treatment method. **Results:** Both ways of lidocaine administration "topical application and iontophoresis" had a significant inhibitory effect on motoneuron pool excitability measured by H-reflex. Topical application of 2% lidocaine had a greater significant effect ( $p > 0.05$ ) on H-reflex excitation level than do iontophoresis. **Discussion and conclusion:** The results of this study may support the use of both techniques for inhibition of H-reflex. The greater significant effect of topical application may be due to the inherent physiological interaction between skin sensors and the motor neuron pool which provides a natural and convenient access for affecting the behavior of the motor system. The weak effect of iontophoresis procedure may come from the fact that it has a deep penetration that affect deeper tissues underneath the skin more than the skin itself.

**Key words:** Lidocaine , Iontophoresis , H-reflex , Topical anaesthesia.

## INTRODUCTION

The effect of afferent discharges from cutaneous receptors in the modulation of muscle stiffness and movement disorders is a point of interest for many researchers. Natural stimuli to the skin are more effective in producing inhibition responses<sup>12</sup>. The monosynaptic

reflexes provided a direct measure of the  $\alpha - \gamma$  motoneurone excitability. It has been reported that spinal reflexes such as the H-reflexes may be facilitated by low threshold shocks delivered to the human cutaneous nerve that supply the skin area overlying the muscle groups<sup>6</sup>. In other studies, skin stimulation was shown to have no relevant effect on spinal reflexes<sup>7</sup>.

Topical anesthesia has been used for long time in relieving somatosensory pain. In addition to analgesic application, topical anesthesia used to increase the limb mobility of stroke and other brain-damaged patients. It takes about 15 to 20 minutes to deaden the spastic muscle, at which point the patient should be able to move the limb during physical therapy, and between 6 to 12 hours afterward. Sabbahi and Deluca attributed the dampen effect of Xyllocaine on H-reflex through the interaction between skin receptors and their possible effect on the modulation of the  $\sigma$ - $\gamma$  motoneurone excitability. The adverse effects of using 10% Xyllocaine are limited to skin dryness, which can be eliminated with skin cream. The topical anesthesia does not affect the central nervous system.<sup>11</sup>

Iontophoresis is introduction of drugs/ to the body using electric current. Lidocaine iontophoresis has been used in different researches for joint and/or muscle pain reduction.<sup>13</sup> It has been reported that the iontophoresed drug may reach up to 3 centimeters inside the body.<sup>3</sup>

The H-reflex is believed to be a compound muscle action potential arising from a muscle through electrical afferent activation of a monosynaptic reflex arc. The afferent pathway of the H-reflex involves electrical activation of large Ia afferent nerve fibers originating from the muscle. After entering the dorsal horn of the spinal cord, the Ia afferents synapse with the alpha motor neurons innervating that muscle. This afferent motor impulse traverses the motor nerves to result in a motor action potential. The complete reflex arc is mediated by Orthodromic sensory and Orthodromic motor neural conduction.<sup>4</sup>

The H-reflex is an electrically evoked equivalent to the monosynaptic stretch. Unlike

- Electromyography machine for recording H-reflex.
- Phoresor II "IOMD Co."
- 3cc polymer-gel electrode.
- 10% Xyllocaine spray.
- 2% lidocaine sodium chloride.

#### Materials and Equipments

This current study was pretest, posttest research design. Twenty normal male subjects participated in this study. Every participant was subjected to two trials of treatment, topical application and iontophoresis.

#### Methods

Twenty male subjects participated in this study. They were recruited from the students of the faculty of physical therapy, cairo university. Their age ranged between 20 and 25 years (mean=22.03 1.38).

#### Subjects

### MATERIALS AND METHODS

The purpose of this study was to compare between topical anesthesia and iontophoresis administration on motoneuron pool excitation as measured by H-reflex in normal subjects.

The purpose of this study was to compare between topical anesthesia and iontophoresis administration on motoneuron pool excitation as measured by H-reflex in normal subjects.

Soleus H-reflex has been shown to be a valid, reliable, and simple method of testing the conduction and integrity of S1 segmental level.<sup>27</sup> To the available knowledge, no previous research studied the efficacy of lidocaine iontophoresis on H-reflex. The aim of this study was to compare the effect of lidocaine topical anesthesia versus lidocaine iontophoresis on H-reflex condition in normal subjects.

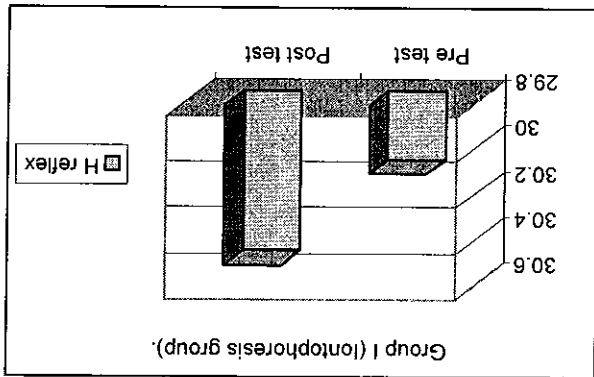
The purpose of this study was to compare between topical anesthesia and iontophoresis administration on motoneuron pool excitation as measured by H-reflex in normal subjects.

*: Significant		
p	0.0001*	
T	6.12	
SD	2.7	2.8
Mean	29.7	30.8
Difference	Pretest	posttest

Table (2): H Reflex values measured by (msec.) before and after treatment in method II (Topical application method).

Table 2 and fig. 2, compare the mean values of H reflex before and after treatment in the topical application method; there is also a significant increase in the H reflex ( $P < 0.05$ ). H reflex showed also a greater increase in the difference between its value before and after treatment in the topical application method than that in the iontophoresis method [Difference was 1.12 (0.71) for the topical application method vs 0.37 (0.28) for the iontophoresis method].

Fig. (1): Comparison between H reflex before and after Iontophoresis.



*: Significant		
p	0.0001*	
T	5.14	
SD	2.5	2.5
Mean	30.1	30.5
Difference	Pretest	posttest

Table (1): H Reflex values measured by (msec) before and after treatment in method I (Iontophoresis method).

As shown in table 1 and fig. 1, comparing the mean values for H-reflex before and after treatment in the iontophoresis method; there is a significant increase in H reflex after treatment ( $P < 0.05$ ).

Results of this study revealed the following:

### I) The iontophoresis method:

## RESULTS

The mean and standard deviations were calculated for all subjects in each method. The paired t test was used to compare the value among each method before and after treatment. Also it was used to compare the differences among the values between the two different methods of treatment. A  $P < 0.05$  was considered statistically significant.

### Statistical Analysis

Participants assumed prone lying position. H-reflex recording was taken from soleus muscle "S<sub>1</sub>". H-reflex value was taken twice, one before and the other 10 minutes after application of topical anesthesia and iontophoresis of 2% lidocaine sodium chloride. Area of application was the mid area of the calf muscles between the two bellies of gastrocnemius muscle. Stimulus intensities required to elicit the soleus H-reflex were 1 to 30 mA. The peak-to-peak amplitude of the reflex was 2 to 12 mV, with an average of 6.2 mV. Reflex shape was triphasic and lasted about 8 to 10 msec. Lidocaine iontophoresis lasted for 20 minutes on 3 mA current intensity to deliver 3cc of 2% lidocaine sodium chloride to the mid of calf area.

### Procedure

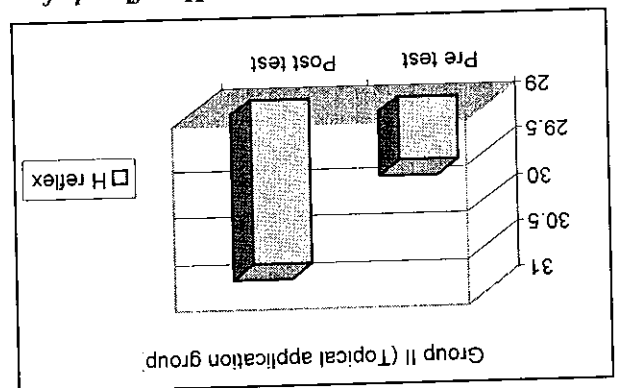


Fig. (2): Comparison between H reflex before and after topical application.

III) Comparing between methods:

Table 3 and fig. 3 showed the treatment method measures before and after treatment and compared the improvement in the iontophoresis method and the topical application method. It was found that there was no significant difference between methods in all parameters before and after treatment, but there was a significant improvement in the topical application method than the iontophoresis method ( $P < 0.05$ ).

	Method I	Method II	t	P
Pretest	30.1 (2.5)	29.7 (2.7)	0.74	0.47
Posttest	30.5 (2.5)	30.8 (2.8)	0.66	0.52
Improve-ment	0.37 (0.28)	1.1 (0.7)	4.7	0.001*

Table (3): Comparison between methods.

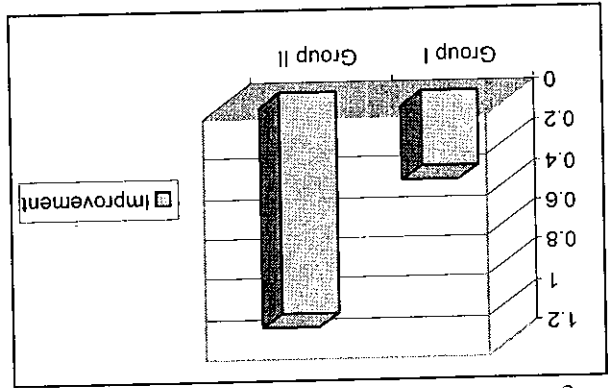


Fig. (3): Comparison between improvements in both methods.

Results from this study may support the efficacy of both techniques, topical application of Xyllocaine, and 2% lidocaine iontophoresis, suggest the greater significant effect of topical application of the anesthetic agent over reflex in human subjects. The decrease in H-reflex peak-to-peak amplitude showed the effectiveness of the drug delivery method on desensitization of the skin. The decreased peak-to-peak amplitude in Soleus H-reflex "from pretest-to-posttest" for the group received topical application of Xyllocaine was more than that of the group received lidocaine iontophoresis. This may be due to the inherent physiological interaction between skin sensors and the motor neuron pool could provide a natural and convenient access for affecting the behavior of the motor system. Skin desensitization was shown to have a substantial effect on the H-reflex. The weak effect of the iontophoresis procedure may come from the fact that its deep penetration that affect deeper tissues underneath the skin than the skin. On the other hand, Xyllocaine

The H-reflex is believed to be a compound muscle action potential arising from a muscle through electrical afferent activation of a monosynaptic reflex arc. The afferent pathway of the H-reflex involves electrical activation of large Ia afferent nerve fibers originating from the muscle. After entering the dorsal horn of the spinal cord, the Ia afferents synapse with the alpha motor neurons innervating that muscle. This afferent motor impulse traverses the motor nerves to result in a motor action potential. The complete reflex arc is mediated by Orthodromic sensory and Orthodromic motor neural conduction.

Results from this study may support the efficacy of both techniques, topical application of Xyllocaine, and 2% lidocaine iontophoresis, suggest the greater significant effect of topical application of the anesthetic agent over reflex in human subjects. The decrease in H-reflex peak-to-peak amplitude showed the effectiveness of the drug delivery method on desensitization of the skin. The decreased peak-to-peak amplitude in Soleus H-reflex "from pretest-to-posttest" for the group received topical application of Xyllocaine was more than that of the group received lidocaine iontophoresis. This may be due to the inherent physiological interaction between skin sensors and the motor neuron pool could provide a natural and convenient access for affecting the behavior of the motor system. Skin desensitization was shown to have a substantial effect on the H-reflex. The weak effect of the iontophoresis procedure may come from the fact that its deep penetration that affect deeper tissues underneath the skin than the skin. On the other hand, Xyllocaine

DISCUSSION

- hemioplegia. Arch Phys Med Rehabil, Vol. 80: 526-530, 1999.
- 6- Hugon, M.: Methodology of the Hoffman reflex. New development in EMG. In J. desmedt, (Ed), Clin. Neurophysiology Vol. III Karger, Basel, 1973.
- 7- Magladery, J.W., Teasdall, R.D., Park, A.M. and Poster, W.E.: Electrophysiological studies of nerve and reflex activity in normal man. "excitation and inhibition of two neuron reflexes by afferent impulses in the same nerve trunk". Bull. Johns Hosp, 88: 520-537, 1951.
- 8- Matthews, W.: The clinical implication of H-reflex and other electrically induced reflex. In Williams D, Modern trends in neurology, Butterworth, London, 241-249, 1970.
- 9- Sabbahi, M.A. and Deluca, C.J.: Topical anesthesia: H-reflex recovery changes by desensitization of the skin. Electrophysiology and neurophysiology, 52: 328-335, 1981.
- 10- Sabbahi, M.A. and Deluca, C.J.: Topical anesthesia: Modulation of the monosynaptic reflexes by desensitization of the skin. Electrophysiology and clinical neurophysiology, 54: 677-688, 1982.
- 11- Sabbahi, M.A. and Deluca, C.J.: Topical anesthetic-induced improvements in the mobility of patients with muscular hypertonicity: Preliminary results. Journal of Electrophysiology and Kinesiology, Vol. 1, 41-48, 1990.
- 12- Sabbahi, M.A. and Sedgwick, E.M.: H-reflex modulation by natural stimulation of the skin. Electroenceph. Clin. Neurophysiol, 41: 537, 1976.
- 13- Sabbahi, S.: Changes in movement and pain following iontophoresis in people with unilateral tempromandibular disorders. Ph.D. dissertation, New York University, 1993.
- 1- American Hospital Formulary Service (AHFS), Drug Information, 1988.
- 2- Braddom, R.I., Johnson, E.W.: Standardization of H-reflex and diagnostic use in Sp radiculopathy. Arch Phys Med Rehabil, 55: 161-6, 1974.
- 3- Costello, C.: Optimization of drug delivery by iontophoresis. Ph.D. dissertation, Texas Woman's University, 1993.
- 4- Dumitru D.: Electrodiagnostic medicine, special nerve conduction techniques. 196-203, 1995.
- 5- Fu-Mei Lin and Mohamed Sabbahi: Correlation of spasticity with hyperactive stretch reflexes and motor dysfunction in

## REFERENCES

topical application may concentrate the medication on wider skin surface than that provided by iontophoresis, giving a chance for the medication to work on the skin receptors. Through skin receptors, depolarization effect by Xyllocaine may inhibit the monosynaptic reflex arc and the motoneurone pool.

**Conclusion and Recommendations**

It was concluded that both methods of treatment by Lidocaine topical application and iontophoresis had an inhibitory effect on motoneurone pool excitation level measured by H-reflex, although the topical application method had the upper hand more than the iontophoresis method.

Further studies was recommended to study the effect of both techniques on the spastic muscles.

التي تتركز في المناطق الحضرية والريفية على حد سواء. وقد أظهرت النتائج أن نسبة كبيرة من السكان في المناطق الحضرية يعانون من مشاكل صحية مختلفة، خاصة في المناطق التي تعاني من التلوث البيئي. كما أن نسبة كبيرة من السكان في المناطق الريفية يعانون من مشاكل صحية مختلفة، خاصة في المناطق التي تعاني من نقص الخدمات الصحية. وقد أظهرت النتائج أن نسبة كبيرة من السكان في المناطق الحضرية يعانون من مشاكل صحية مختلفة، خاصة في المناطق التي تعاني من التلوث البيئي. كما أن نسبة كبيرة من السكان في المناطق الريفية يعانون من مشاكل صحية مختلفة، خاصة في المناطق التي تعاني من نقص الخدمات الصحية.

**تأثير التلوث البيئي على الصحة العامة في المناطق الحضرية والريفية**

المؤلف: الدكتور محمد أحمد محمد