The Immediate Effect of Interferential Current on Pain and Passive Range of Motion of the Shoulder in Patients with Hemiplegic Shoulder Pain: A Pilot Study

ผลทันทีของการกระตุ้นไฟฟ้าด้วยกระแสอินเตอร์เฟอเรนท์ต่ออาการเจ็บและช่วงการเคลื่อนไหวแบบทำให้บริเวณไหล่ในผู้ป่วยที่มีการเจ็บไหล่ข้างอัมพาต: การศึกษานำร่อง

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ABSTRACT

This study aimed to evaluate the immediate effect of interferential current stimulation (IFC) on pain and passive range of motion (PROM) of the shoulder in patients with hemiplegic shoulder pain (HSP). Participants in this study were five patients with HSP. IFC was applied to all patients. Pain intensity and PROM in all shoulder directions were measured before and after applying IFC. The results showed that pain on the most painful movement was significantly decreased ($p < 0.05$). Additionally, the significant increase in PROM to the onset of pain was found in the directions of shoulder flexion ($p < 0.05$) and shoulder internal rotation ($p < 0.05$). These results indicated that IFC could decrease pain intensity and increase PROM of the shoulder in patient with HSP.

บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาผลทันทีของการกระตุ้นไฟฟ้าด้วยกระแสอินเตอร์เฟอเรนท์ต่ออาการเจ็บและช่วงการเคลื่อนไหวแบบทำให้บริเวณไหล่ในผู้ป่วยที่มีการเจ็บไหล่ข้างอัมพาต ผู้เข้าร่วมงานวิจัยนี้เป็นผู้ป่วยที่มีการเจ็บไหล่ข้างอัมพาตจำนวน 5 คน ทุกคนได้รับการกระตุ้นไฟฟ้าด้วยกระแสอินเตอร์เฟอเรนท์ ค่าความเจ็บที่ไหล่และช่วงการเคลื่อนไหวแบบทำให้ในทุกทิศทางของไหล่ถูกวัดก่อนและหลังการกระตุ้นไฟฟ้า ผลการศึกษาพบว่าอาการเจ็บไหล่ขณะเคลื่อนไหวในทิศทางที่เจ็บมากที่สุด มีค่าลดลงอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) นอกจากนี้ช่วงการเคลื่อนไหวแบบทำให้ของไหล่ มีค่าเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ ในทิศทางการงอ ($p < 0.05$) และการหมุนเข้าด้านใน ($p < 0.05$) ผลการศึกษานี้บ่งชี้ว่าการกระตุ้นไฟฟ้าด้วยกระแสอินเตอร์เฟอเรนท์สามารถลดอาการเจ็บและเพิ่มช่วงการเคลื่อนไหวแบบทำให้ที่บริเวณไหล่ในผู้ป่วยที่มีการเจ็บไหล่ข้างอัมพาตได้

Key Words: Hemiplegic shoulder pain, Interferential current stimulation, Stroke

คำสำคัญ: การเจ็บไหล่ข้างอัมพาต การกระตุ้นไฟฟ้าด้วยกระแสอินเตอร์เฟอร์เรนท์ โรคหลอดเลือดสมอง

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Introduction

Hemiplegic shoulder pain (HSP) is one of the most common stroke complications (Griffin, 1986). It was defined as pain on the shoulder and/or C5 dermatome of the contralesional side with an onset after stroke (Roosink et al., 2011). The prevalence of HSP was reported vary from 9% to 73% depending on the onset time and level of arm function (Teasell et al., 2011). Pain, that was occurred, was associated with reduced shoulder range of motion (Griffin, 1986), decreased qualities of life in patients with stroke (Chae et al., 2007) and delayed post- stroke recovery (Roy et al., 1995).

There were several treatments aiming to reduce HSP. There included pharmacological and non-pharmacological treatment (Teasell et al., 2011). Physical therapy played an important role in the non-pharmacological treatment. There were a number of physical therapy interventions for management of HSP such as positioning of the shoulder, slings and other aids, exercise therapy in the hemiplegic shoulder (Teasell et al., 2011), strapping the hemiplegic shoulder (Hanger et al., 2000, Griffin & Bernhardt, 2006), massage therapy (Mok & Woo, 2004) and electrical stimulation (Price & Pandyan, 2001).

Interferential current stimulation (IFC) is one of the modalities clinically used for pain relief (Fuentes et al., 2010). IFC is the transcutaneous application of alternating medium-frequency electrical current for therapeutic purposes. The property of medium carrier frequency of IFC could be lower skin impedance and allow deeper penetration (Goats, 1990). IFC has been evidenced to be an intervention for reducing pain in experimental pain model included cold and mechanically induced pain (McManus et al., 2006). In addition, IFC was a significant modality for pain relief in various pain conditions such as knee pain (Adedoyin et al., 2002), and frozen shoulder (Cheing et al., 2008). However, there has presently been lack of evidence reported the effect of IFC on HSP. Therefore, this pilot study was conducted to investigate the immediate effect of IFC on pain and pain-free passive range of motion (PROM) of the shoulder in patients with HSP.

Methodology

This study was a pretest-posttest study design. All study protocols were approved by the Ethic Review Committee for Research Involving Human Projects, Chulalongkorn University and Prasat Neurological Institute. Informed consents were obtained from participants who agreed to participate and were previously informed about purposes and testing procedures of this study.

Participants

Participants were recruited from institutional physical therapy clinic or neurological rehabilitation center in Thailand. Participants were screened by the investigator, who is a physical therapist. Inclusion criteria were:

- Diagnosed as the first stroke (ischemic or hemorrhagic)
- Pain within 3 months of their stroke onset at an affected shoulder during rest or movements at least or equal 3 on 11- points numerical rating scale
- Adequate communication ability to cope with a numerical rating scales for pain in Thai
- Normal light touch and pin prick sensation on the affected shoulder
- Brunnstrom motor recovery on stages 1-3

- No cognitive impairment, detected by Mini Mental Status Exam-Thai 2002 (score more than or equal 24 points)
- No history of ventricular arrhythmias or any arrhythmia with hemodynamic instability
- No unresolved shoulder pathology and ongoing symptoms prior to the onset of stroke on the affected limb,
- No history of cancer or tumor
- No cardiac pacemaker implanted
- No skin problems, wound or infected wound on the affected shoulder
- No currently take Botulinum Toxin or steroid injections, subscapular nerve block and surgery at the shoulder joint
- No take analgesic medication in the past 12 hours

An exclusion criterion was:

- Cannot complete the treatment session.

Outcome Measures

The outcomes of this study were pain intensity and pain-free PROM of the shoulder. Pain intensity was assessed by 11-point numeric rating scale (NRS) (Ferreira-Valente et al., 2011) during rest and on the worst movement. Pain-free PROM of the shoulder was designated as the range of motion attained at the "point of first onset of pain" and was measured by digital goniometer in six directions: flexion, extension, abduction, adduction, internal rotation and external rotation. Before collecting data, test-retest reliability was evaluated with intraclass correlation coefficient (ICC). The values of intrarater reliability were good (0.73 to 0.97). The minimal detectable change (MDC) of measurements for all PROM of the shoulder was found to be within 4.5 degree.

Procedure

At the beginning of treatment, the investigator recorded demographic data and pretreatment data of participants. The demographic data consisted of age, gender, hemiplegic side, stroke duration (the time from the onset of stroke to the time they entered the program), and pain duration (the time from the onset of pain to the time they entered the program). The pretest data included shoulder pain at rest, pain on the most painful movement and pain-free PROM of the shoulder in all directions.

Then, all participants were set in a sitting position with elbow support. The skin overlying the affected shoulder was wiped with alcohol. Four electrodes (56 mm.x 56mm) were placed around the painful area of the shoulder using the criss-cross technique to deliver quadripolar interferential current.

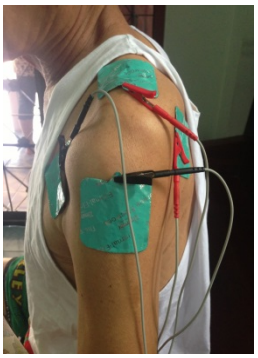

Figure 1 Electrodes placement

Participants were told that they would feel a strong tingling but comfortable sensation at the shoulder. The parameters of IFC were set. The amplitude-modulated frequency (AMF) was 100 Hz on vector mode (Goat, 1990). The current intensity was adjusted to the level that made participants have a strong tingling sensation (Moran et al., 2011). The intensity level was adjusted to ensure that participants

still had the same feeling throughout treatment (Pantaleão et al., 2011). A treatment time of stimulation was set at 20 minutes (Fuentes et al., 2010).

After applying the IFC, participants were immediately reassessed for pain intensity and pain-free PROM of the shoulder. After finishing the program, all participants were received a conventional physical therapy program as they were in.

Data analysis

Mean and standard deviation (SDs) were calculated for the demographic data and all variables. The paired t-test was used to analyze within group effect. All data were analyzed using the SPSS program version 17.0 for window. The significant level was set at p-value less than 0.05. The clinical important change for pain on NRS was set to be more than 2 (Farrar et al., 2001).

Results

Five participants were recruited in this study. The demographic data were showed in table 1. At the baseline, all participants reported no pain at rest. In this study, all participants reported that mostly painful movement was occurred when their shoulders were passively moved in flexion direction. The mean and SDs of the baseline, post-treatment and the change scores of all variables were showed in table 2. Statistical analysis showed that pain on the most painful movement was significantly decreased with p = 0.019. Additionally, the significant increase in pain-free PROM of shoulder flexion (p= 0.010), and shoulder internal rotation (p = 0.022) were noted.

Table 1 The demographic data (N=5)

Variables	Mean ± SD
Age (years)	65.4 ± 11.4
Sex (male/female)	2/3
Hemiplegic side (right/left)	3/2
Stroke duration (days)	110.4 ± 16.1
Pain duration (days)	61.6 ± 15.2

Discussion and Conclusions

This study was the pilot report on the immediate effect of IFC in management of HSP. The results suggest that the IFC was effective in pain reduction on the most painful movement. This finding extended the conclusions of several clinical studies supporting the effectiveness of the IFC for musculoskeletal pain (Adedoyin et al., 2002; Cheing et al., 2008) and experimental pain (McManus et al., 2006). The decreased pain score on the most painful movement in this study was significant clinical relevant (Farrar et al., 2001). However, the production of an analgesic effect of IFC is unclear. An analgesic effect of IFC was similar to that of transcutaneous electrical nerve stimulation (Johnson, 2001). Application of IFC amplitude at AMF 100 Hz possibly produce a pain reduction through the gate control theory (Melzack & Wall, 1965), the physiological nerve block (De Domenico, 1982), and the endogenous pain inhibitory system (Sluka & Walsh, 2003).

Table 2 Baseline, post-treatment and change scores of all variables

Variables	Baseline	Post-treatment	Change scores	p-value
Pain intensity on the most painful movement (NRS)	6.80 ± 0.45	4.00 ± 1.73	2.80 ± 1.64	0.019*
Pain-free PROM of the shoulder (degree)				
Flexion	142.88 ± 12.14	153.98 ± 10.29	11.10 ± 5.38	0.010*
Extension	36.70 ± 1.60	37.26 ± 1.58	0.56 ± 0.56	0.089
Abduction	133.20 ± 28.15	149.40 ± 20.09	16.20 ± 13.95	0.060
Adduction	32.08 ± 5.03	32.58 ± 5.09	0.50 ± 0.48	0.082
Internal rotation	54.00 ± 18.48	60.86 ± 17.06	6.86 ± 4.22	0.022*
External rotation	63.28 ± 12.32	68.54 ± 9.01	5.26 ± 5.16	0.085

*represents statistically significant difference ($p < 0.05$)

The use of the IFC was also significant in increasing in PROM of the shoulder to the onset of pain including flexion and internal rotation with the mean change of 11.1 and 6.86 degrees, respectively. The mean change in pain-free PROM of the shoulder was greater than the clinical important change (4.5 degrees). This result may contribute that PROM was gained when pain was relieved.

However, interpreting these results would be with care because this study conducted with a small sample size. In order to generalize these results, a further study needs to investigate a large number of subjects. Additionally, a further study is indicated to compare the effectiveness of the use of the IFC to placebo or control in order to best select an appropriate technique for HSP.

In conclusion, the IFC was evidenced in relieving pain and improving the pain-free PROM in treatment of patients with HSP.

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