

## Bee Venom Phonophoresis for the Treatment of Acute Pain Following Inguinal Hernia Repair

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**Abstract:** *Background:* Bee venom (BV) phonophoresis has been suggested as a noninvasive treatment for a number of inflammatory conditions and in reducing post-operative acute pain. Aim of the study: to determine the impact of bee venom phonophoresis in reducing acute pain in patients with indirect unilateral inguinal hernioplasty. *Subjects:* Thirty male participants aging from 28-50 years suffering from acute pain following indirect unilateral inguinal hernioplasty were selected randomly from El Sheikh Zayed Al-Nahyan Hospital, Cairo, Egypt, they were randomly divided into 2 groups: study group (Group A) received bee venom phonophoresis with pulsed ultrasound (applicator 1.9 cm<sup>2</sup>) had been applied around the incision site, the movement was over the incision margins with pulsed duty cycle 40% (4 ms on, 6 ms off) and Power density 0.5 W/cm<sup>2</sup> and Time was 5 minutes each session. Treatment sessions were 3 sessions a week, for 3 consecutive weeks with drug withdrawal and a control group (Group B) received low intensity pulsed ultrasound (applicator 1.9 cm<sup>2</sup>) had been applied around the incision site, the movement was over the incision margins with pulsed duty cycle 20% (2 ms on, 8 ms off) and Power density 0.8 W/cm<sup>2</sup> and Time was 5 minutes each session. Treatment sessions were 3 sessions a week, for 3 consecutive weeks and medical care. Measurements were conducted before starting the treatment as a first record and at the end of the last session of the treatment as a second (final) record. The study was carried out from June 2020 to December 2020. Statistical analysis for pain was done by unpaired t-test and chi-Squared. *Methods of Evaluation:* Visual analogue scale (VAS) and Manual Goniometer. *Results:* there was a significant decrease in VAS and increase in hip range of motion (ROM) with using bee venom phonophoresis following indirect unilateral inguinal hernioplasty. *Conclusion:* bee venom phonophoresis is a beneficial method in reducing acute pain following indirect unilateral inguinal hernioplasty.

**Key words:** Bee Venom • Phonophoresis • Inguinal Hernia and Pain

### INTRODUCTION

Inguinal hernia is a protrusion of a viscus through the lining of the abdominal cavity which forms and extends into the inguinal canal. In males, the spermatic cord and testicles descend out from inside the abdomen and through the abdominal lining to the scrotum through the inguinal canal [1].

Inguinal hernia repair is one of the most commonly performed procedures in Egypt today, Approximately 800, 000 cases are performed annually. The open tension-free

mesh unilateral indirect hernioplasty is performed under local anesthesia, The procedure is time tested, safe, economical, as well as quick and easy to perform. In addition, it carries some complications as delayed wound healing, acute post-operative pain and hernia recurrence [2].

Several mechanisms have been suggested for the etiology of the postsurgical acute pain, the most commonly suggested mechanism is neuropathic pain caused by activation or inflammation of high threshold peripheral sensory neurons or direct nerve injury in or

near the surgical field. Postoperative analgesia, Nerve block, opioids, morphine, tramadol and physiotherapy modalities could be used for acute pain relief following inguinal hernioplasty as transcutaneous electrical nerve stimulation [TENS], Interferential Current, Ultrasound and laser [3].

BV had been used in the treatment of different pain conditions: Neck pain, low back pain, herniated lumbar pain and disc pain, acute post-operative pain, acute ankle sprain, wrist sprain, rheumatoid arthritis and knee osteoarthritis [4].

Phonophoresis is a transdermal drug-delivery system that uses ultrasound to enhance the delivery of topically-applied drugs. The Use of ultrasound in therapeutics and drug delivery has gained importance in recent years as it's a non-invasive and safe method for pain relief whereas the study ends to use bee venom phonophoresis for reducing acute pain following unilateral inguinal hernioplasty [5]. So, the aim of the study: to determine the impact of bee venom phonophoresis in reducing acute pain in patients with indirect unilateral inguinal hernioplasty.

## MATERIALS AND METHODS

Thirty male participants met the inclusion criteria to participate in this study, they were selected from El Sheikh Zayed Al-Nahyan Hospital , Cairo, Egypt, the study was compacted from June 2020 to December 2020 , participants were divided randomly into 2groups: study group [Group A] received bee venom phonophoresis with pulsed ultrasound [applicator 1.9 cm<sup>2</sup>] had been applied around the incision site, the movement was over the incision margins with pulsed duty cycle 40% [4 ms on, 6 ms off] and Power density 0.5 W/cm<sup>2</sup> and Time was 5 minutes each session. Treatment sessions were 3 sessions a week, for 3 consecutive weeks with drug withdrawal and a control group [Group B] received low intensity pulsed ultrasound [applicator 1.9 cm<sup>2</sup>] had been applied around the incision site, the movement was over the incision margins with pulsed duty cycle 20% [2 ms on, 8 ms off] and Power density 0.8 W/cm<sup>2</sup> and Time was 5 minutes each session. Treatment sessions were 3 sessions a week, for 3 consecutive weeks and medical care.

**Inclusive Criteria Included:** All participants were referred to the Physical Therapy Department at El Sheikh Zayed Al-Nahyan Hospital, Cairo, Egypt, with a primary unilateral inguinal hernioplasty suffering from post-operative acute pain; there ages were ranging from 28-50 years, all participants were males.

**Exclusive Criteria Included:** Participants were excluded if they met those criteria: Participants with open or infected wound, Participants with Allergy to bee venom, Participants who had been treated using chemo or radiotherapy. Participants who had associated disorders, immunodeficiency, HIV, diabetes or anemia, Participants suffered from mental or psychological disorders, Participants suffered from any systemic diseases that may interfere with the objectives of the study and Participants with musculoskeletal complications that exacerbate the pain sensation.

**Ethics:** The protocol of this study was approved by the ethical committee board of the Faculty of Physical Therapy Cairo University; Giza, Egypt [No:P.T.REC/012/002764]. Every Participant applied informed consent before starting the study. All participants were informed about the nature and the effect of the treatment and measurement tools. The Participants were also instructed to report any side effects during the treatment protocol as: itching....

## Measurements

**Visual Analogue Scale [VAS]:** It's a continuum of 100m/10cm starting with no pain and ended with maximum pain was used as a documentation method for pain assessment [6].

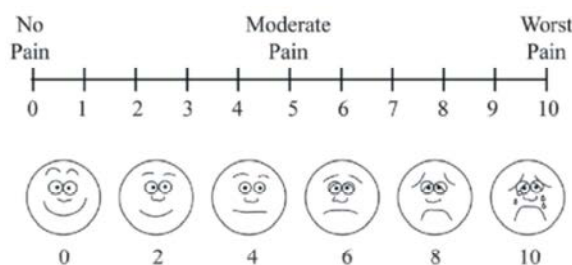


Fig. 1: VAS for pain assessment

**Manual Goniometer:** It's a valid and reliable method for measurement of hip joint range of motion affection following inguinal hernia repair [7].

**Treatment Procedures:** Group A [Study Group] participants were comfortably relaxed in supine position, any clothes above the abdomen were removed, the incision site was cleaned using alcohol, the plug of the ultrasound unit was inserted into the main current supply, the treatment approach [phonophoresis application for bee venom gel] had been prepared , each participant received 0.6 mg up to maximum 1 mg BV gel each session, pulsed ultrasound [applicator 1.9 cm<sup>2</sup>] had been applied

around the incision site, the movement was over the incision margins with pulsed duty cycle 40% [4 ms on, 6 ms off] and Power density 0.5 W/cm<sup>2</sup> and Time was 5 minutes each session with drug withdrawal. Treatment sessions were 3 sessions a week, for 3 consecutive weeks starting 24h following primary unilateral inguinal hernioplasty [8].

Group B [Control Group] were received only low intensity ultrasound pulsed ultrasound [applicator 1.9 cm<sup>2</sup>] had been applied around the incision site, the movement was over the incision margins with pulsed duty cycle 20% [2 ms on, 8 ms off] and Power density 0.8 W/cm<sup>2</sup> and Time was 5 minutes each session. Treatment sessions were 3 sessions a week, for 3 consecutive weeks starting 24h following primary unilateral inguinal hernioplasty and medical care [8].

**Statistical Procedures:** Descriptive statistics and unpaired t-test were conducted for comparison of age between both groups. Chi- squared was carried out for comparison of affected side distribution between groups. Unpaired t-test was conducted to compare the mean

values of VAS and hip ROM between the group A and B. Paired t-test was conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at  $p < 0.05$ . All statistical analysis was conducted through the statistical package for social studies [SPSS] version 25 for windows [IBM SPSS, Chicago, IL, USA].

## RESULTS

**Subject Characteristics:** Table (1) showed the subject characteristics of the group A and B. There was no significant difference between both groups in the mean age and affected side distribution [ $p > 0.05$ ].

### Effect of Treatment on VAS and Hip ROM

**Within Group Comparison:** There was a significant decrease in VAS post treatment compared with that pretreatment in the group A and B [ $p > 0.001$ ]. The percent of decrease in VAS in the group A was 77.19% while that in the group B was 59.44%. There was a significant increase in hip ROM post treatment compared with that

Table 1: Comparison of subject characteristics between group A and B:

	$\bar{x} \pm SD$		
	Group A	Group B	p-value
Age [years]	36.33 ± 8.26	37.66 ± 7.39	0.64
Affected side			
Right side	9 [60%]	11 [73%]	0.43
Left side	6 [40%]	4 [27%]	

$\bar{x}$ , mean; SD, standard deviation; p value, probability value

Table 2: Mean VAS, hip flexion, extension, abduction and adduction ROM pre and post treatment of the group A and B:

	Group A $\bar{x} \pm SD$	Group B $\bar{x} \pm SD$	MD	t- value	p value
VAS					
Pre treatment	8.46 ± 1.06	8.53 ± 1	-0.07	-0.17	0.86
Post treatment	1.93 ± 0.96	3.46 ± 1.18	-1.53	-3.88	0.001
MD	6.53	5.07			
% of change	77.19	59.44			
t- value	15.41	12.42			
	p = 0.001	p = 0.001			
Flexion ROM [degrees]					
Pre treatment	107.66 ± 5.93	108.6 ± 6.2	-0.94	-0.42	0.67
Post treatment	140.8 ± 5.32	133.06 ± 4.77	7.74	4.19	0.001
MD	-33.14	-24.46			
% of change	30.78	22.52			
t- value	-17.15	-10.67			
	p = 0.001	p = 0.001			
Extension ROM [degrees]					
Pre treatment	5 ± 3.77	4.33 ± 3.6	0.67	0.49	0.62
Post treatment	18 ± 4.55	13.4 ± 3.37	4.6	3.14	0.004
MD	-13	-9.07			
% of change	260	209.47			
t- value	-12.16	-9.87			
	p = 0.001	p = 0.001			

$\bar{x}$ , mean; SD, standard deviation; MD, mean difference; p-value, probability value

pretreatment in the group A and B [ $p > 0.001$ ]. The percent of increase in flexion and extension in the group A were 30.78 and 260% respectively while that in the group B were 22.52 and 209.47 % for flexion and extension respectively (Table 2).

**Between Group's Comparison:** There was no significant difference in VAS and ROM between both groups pre-treatment [ $p > 0.05$ ]. Comparison between both groups post treatment revealed a significant decrease in VAS of the group A compared with that of the group B [ $p > 0.001$ ]. Also, there was a significant increase in flexion [ $p < 0.001$ ] and extension [ $p < 0.01$ ] of the group A compared with that of the group B. (Table 2).

## DISCUSSION

Lichtenstein's inguinal hernioplasty performed under local anesthesia has short post anesthesia recovery period, lesser complications and shorter hospital stay. In western world most of the hernioplasty are done as day care procedure. The procedure is well suited for smaller community-based, regional and teaching hospitals and it offers good immediate and long-term results. Moreover, the excellent results achieved with the open tension free mesh hernioplasty appear to be unrelated to the surgeons' experience. The technique has been evaluated in large series and has become popular among surgeons all around the world. Open tension free Lichtenstein hernioplasty is suitable for all adult patients of inguinal hernia irrespective of age, weight, general health and the presence of concomitant medical problems [9].

Acute pain after hernia surgery can affect more than half of patients because of improper treatment prior to the operation. Various analgesics could not provide patient satisfaction with postoperative pain treatment. Moreover, opioid drugs may be inappropriate to relieve pain at any dose level without respiratory depression, unbearable nausea, itching and constipation. In addition, inadequate pain treatment is related to prolonged hospitalization, more intense pain and increased health care costs [10].

Bee venom is a complex mixture of proteins, peptides and low molecular components. Nowadays its components have been characterized. The main components are proteins and peptides [11].

Phonophoresis [usually associated with higher frequencies: 1 or 3 MHz] Ultrasound frequency is a main factor in transdermal drug-delivery enhancement of phonophoresis. However, whether high- or low-frequency phonophoresis is more effective for transdermal drug delivery in humans is unknown. Investigators initially

hypothesized that higher frequencies would lead to more ultrasound energy concentrated in the epidermis due to the inverse relationship with frequency and tissue absorption. Therefore, more substantial transdermal drug-delivery enhancement would occur with higher frequencies. Phonophoresis increases drug penetration through the skin during and after the treatment by cavitation, distorting structured lipids in the stratum corneum. This disorientation in the epidermis increases the skin's permeability, allowing the topical drug, especially when it has a low molecular weight, to penetrate the dermis. A concentration gradient with high drug concentrations at the skin surface and low levels deeper in the tissues allows for the topical drug to slowly diffuse through the tissue's layers [12].

Results of this study concerning the efficacy of bee venom phonophoresis in reducing acute pain in patients following indirect inguinal hernioplasty that observed and recorded by Lee *et al.* [13], Cho *et al.* [14], Chen and Lariviere [15], Jang and Kim [16], Yasin *et al.* [17] Lin and Hsieh [18], Park *et al.* [19], De Santana *et al.* [20].

Lee *et al.* [13] reported that In Oriental medicine, BV is used as a local anesthetic and anti-inflammatory agent. Injecting BV into tissue can control inflammation and pain while reinforcing immunity. BV has the unique pharmacological function of stimulating the immune system as a biochemical foreign body. The main ingredients of BV are various enzymes, peptides and low-molecular-weight organic substances [non-peptide substances]. The main peptides in BV are melittin, apamin and adolapin and they have powerful anti-inflammatory and analgesic functions. Local analgesic and anti-inflammatory factors are activated in lesions by injecting BV, as the level of cortisol in blood is elevated and the biosynthesis of prostaglandin is inhibited Cho *et al.* [14] reported that BV had both anti-inflammatory and analgesic actions.

Chen and Lariviere [15] reported that The traditional therapy of BV as in the treatment of arthritis was direct stings by bees, this method induced pain and inflammation, or BV injection into acupoint is an invasive technique causing severe pain, also the bee stings have no control over the exact dose which may lead to poor patient compliance For these causes the need of another method for the application of BV is very important.

Jang and Kim [16] reported that used ultrasound device for BV delivery in treating of soreness of the biceps brachii muscle, as phonophoresis was found to be an effective method for pain relief and improvement in range of motion. It has been reported that BV inhibits COX-2 and prostaglandin E2 in the body, suggesting that

it may be effective in treating inflammation in various parts of a joint. In particular, the treatment effects have been reported in participants with hip osteoarthritis, indicating that it improves the hip joint mobility. BVA involves BV being injected directly into the skin, but BV gel phonophoresis and BV ointment are indirect methods. However, during phonophoresis, transdermal drug delivery is enhanced by ultrasound waves.

Yasin *et al.* [17] reported that. Phonophoresis is a noninvasive method in which the ultrasound waves are used to enhance transdermal drug delivery.

Lin and Hsieh [18] reported that for ointments, it is difficult for the large-molecular-weight BV particles to penetrate the skin, which may have limited their effects. Therefore, although BV injections may be effective because they are highly absorbent, they cause severe pain.

Park *et al.* [19] Reported that BV phonophoresis is suggested as an alternative. A comparative study of the effects of BV injections and BV phonophoresis should be conducted to determine whether they are safe and effective treatment methods. In particular, the fact that Korean medicine doctors use BV phonophoresis for musculoskeletal diseases [frequency of 41.7%], post-operative acute pain [18.0%] and gastrointestinal diseases [9%] indirectly shows that BV phonophoresis affects musculoskeletal disorders and reduces the acute pain.

De Santana *et al.* [20] reported that despite its toxicity, bee venom has also been utilized for therapeutic purposes in many clinical cases. Bee venom therapy (BVT) is used for various diseases and in particular, it is known to be effective for musculoskeletal diseases, including arthritis, arthralgia and immune-related diseases because bee venom has anti-inflammatory and analgesic effects.

## CONCLUSION

It was concluded that the bee venom phonophoresis is an effective treatment in reducing acute pain following indirect inguinal hernioplasty.

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