Effect of High Voltage Pulsed Galvanic Stimulation on Pain and Edema Control in Post Mastectomy Lymphoedema

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ABSTRACT

The aim of this study was to investigate the effect of high voltage pulsed galvanic stimulation (HVPGS) on improvement the upper extremity function via controlling pain and reducing edema formation in post modified radical mastectomy lymphoedema cases. Thirty patients who had modified radical mastectomy were randomly assigned to two groups represent the sample of the study. Their ages ranged from 35-55 years and they had arm lymphoedema ranged from mild, moderate to severe. The edema formation was determined by tape circumferential method and pressure threshold was judged by using pressure Algometer. These measurements were conducted before and after application of treatment (for one and two months). Post mastectomized patients were divided into two equal groups (A and B). Group (A) was considered to be a placebo one receiving traditional physical therapy program plus placebo HVPC (with no intensity), while group (B) was a study group receiving high voltage pulsed current in addition to the traditional postoperative physical therapy program given to group A. Each patient in each group received 3 sessions per week for a period of two months. The results of this study indicated a significant increase in pressure threshold and decrease in edema formation after application of HVPC for one and two months in the study group when compared to the results of placebo one. This improvement was attributed to the effect of HVPGC in increasing interstitial pressure of the tissues by increasing muscular pump and regulating fluid reabsorption in the affected tissues, therefore HVPG stimulation plays vital role in post mastectomy rehabilitation.

Key wards: *HVPGS, Mastectomy, Lymphoedema, Rehabilitation.*

INTRODUCTION

The upper extremities are very critical to the interaction with environment. The upper limbs play an important role to perform and maintain various tasks of daily living activities and functions.

Breast cancer is a major cause of morbidity and mortality in women[16]. A modified radical mastectomy was defined as any excision of the breast and retraction of the pectoralis major with or without removal of pectoralis minor, the axilla is maintained and there is no hallowing below the clavicle[7]. One of the common complications of post-mastectomy is edema (lymphoedema). Lymphoedema can occur in any part of the body but it is most commonly seen in the arm

due to impairments or limited drainage routes from these areas[12].

One of the common standard ways of lymphoedema assessment is girth measures.

Early physiotherapy after all forms of surgical treatment of breast cancer is an important procedure resulting in better shoulder movement.

Such tools may improve functional capacity of upper extremities and prevent unacceptable postoperative results[17].

High voltage pulsed galvanic current has been used in many physical therapy clinics for reducing edema, reducing pain, healing ulcers, increasing joint mobility, preventing disuse atrophy and increasing strength of deep muscle fibers by recruiting of motor units[2].

MATERIALS AND METHODS

Subjects

Thirty females patients who had modified radical mastectomy and were being treating at National Institute of Cancer, Cairo University (Department of Physical Therapy, Outpatients Clinics). They were randomly classified into 2 various groups of the study (A and B groups). These groups of the patients ranged in ages from 35-55 years.

Group (A) placebo HVPGS group, 15 females who had postmastectomy lymphoedema and they were treated by traditional physical therapy program (breathing ex., postural drainage, and exercise therapy for upper extremity in both affected and sound sides with placebo HVPGS (with zero intensity). Group (B) HVPGS group, 15 females who had postmodified radical mastectomy lymphoedema and were treated by traditional methods of physical therapy plus application of high voltage galvanic stimulation.

Equipment

HVPG Stimulator

A dynamax 11 HVPC SN.2. 930 Stimulator. This equipment is manufactured by U.S. Medical Crop. The stimulator produces a twin peake pulse, with about 75-μs spacing between pulses and has adjustable output of 0 to 500 V and an adjustable frequency of 1 to 140 pps. The stimulator also allows continuous or pulsed modes.

Tape Measures

These are circumferential measurements of upper extremity by placing and marking the most prominent aspect of the olecranon process by using tape centimeter. This tool is used to measure the amount of edema formation at five levels.

Pressure Algometer

This device is used to measure pressure threshold (minimal pressure that induce pain) it manufactured by Gorge Medical Hood River, No 5, 301, 683 made in U.S.A..

The pressure Algometer device consists of a rubber disc attached to the pole of a pressure gauge.

The gauge is calibrated in Kg or pounds. Sometimes, the readings are expressed in Kgs per square centimeter (Kg/cm^2).

Procedure of the study

Before starting, the purposes and procedures of the study should be explained properly to the patient to reduce patient's fear from the electricity and to be aware of the other parts of the study.

a) Measurement procedure

The measurements phases (measurements of edema formation and pain pressure threshold) were conducted before the first session (pre treatment application) and after one and two months initiation of the treatment (post treatment one and two months). This stage was divided into two various measuremental steps:

1. Measurement of edema formation

This procedure is conducted by using a tape measure to evaluate the circumference of the affected upper extremity at 5 levels of measurements (around olecranon, above olecranon 5 and 10 cm and below olecranon 5 and 10 cm levels) according to Wingate[20]. The mean value of 3 trials was calculated and recorded.

2. Measurement of pain threshold

The patient was in sitting position and asked to identify the maximum tender spot and mark it. The investigator palpated on the painful area with his finger tip to identify the maximum points of sensitivity. The measurement of pressure threshold was achieved by applying the pressure gauge at 90° vertical angle to the skin. The patient was instructed to say yes when she starts to feel a pain, the mean of 3 trials was calculated[5].

b) Treatment procedure

1. HVPGC treatment protocol

The patient was in sitting position in a chair with back support and the affected upper extremity was elevated above the heart level 30°. The pad electrode was placed over the edematous area of forearm for 15 min with a wet cloth placed between the electrodes and the patient's skin.

An adhesive tape was used to hold the electrode on place over the edematous area. The dispersive electrode (30×35 mm) was strapped over the medial aspect of the thigh. The main power switch was turned on. HVPG stimulation was applied with a technique of low rate frequency with amplitude just sufficient to elicit muscle contraction, duty cycle from 1-4 to prevent muscular fatigue. Frequency was 8 pulses/second and polarity was negative and continuos mode[8]. The duration of the treatment was 30 min, the frequency of the treatment protocol for each patient of this group was three sessions per week for two months.

2. Placebo HVPG current procedure

With the placebo HVPG group (comparison group) all previous procedure as study group were be repeated but they received placebo HVPG (no intensity).

RESULTS

The results of this study are presented under the following headings:

I. Results of placebo HVPGC group

a) Pressure threshold

As shown in table (1), the mean value of pressure threshold in the placebo HVPGC group (pre treatment) was 6.27 ± 0.77 Lbs/in^2, while the mean values of pressure threshold at the end of the first and second month post application of the treatment in the placebo group were 6.74 ± 0.74, and 7.25 ± 0.71 Lbs/in^2, which represent 7.5% and 15.63% of the pre application value respectively.

As observed from table (1): in the placebo group, there were non significant differences in the pressure threshold at the end of first and second months post application compared to those values of pre treatment application ($P>0.05$). Fig. (1) shows the mean values of pressure threshold of two various groups of the study (placebo HVPGC and HVPGC groups).

b) Edema formation (placebo HVPGC group)

* 10 cm above olecranon level

As observed from table (2), the mean values of the edema formation at the 10 cm above olecranon level of the placebo HVPGC group at the lymphedematous arm (pre application, after one and two months of treatment application) were (46.8±6.07, 46.25±6.16; and 44.68±5.84cm) respectively, the percentage of reductions at this level of measurement after one and two months of treatment application represent ↓ 1.28% and 4.53% from pre application respectively.

The statistical analysis of the mean differences of the edema formation provided the following results: There were significant reduction ($P<0.001$) when compared with the same values of pre treatment application.

* 5 cm above olecranon level

As shown in table (2), the mean value of pre treatment application level of the placebo HVPGS groups was 43.88±4.78 cm, while the mean values of the edema formation of this group after one and two months of the treatment application were 43.23±4.57, and 42.68±4.51 cm respectively which indicated a significant reduction ($P<0.0001$) when compared with the same values of pre application. The percentage of improvement at this level of measurement after one and two months represent ↓ 1.46% and ↓ 2.73 respectively from pre application.

* Around olecranon level

As shown in table (2), the mean value of edema formation in this group before treatment was 38.35±3.48 cm, while after one month of the treatment application, it was 37.96±3.47 cm which represented ↓1.016% reduction of the pre treatment value. An initial reduction in edema formation is noticed after one month of treatment application when compared to the baseline value measured before the treatment ($P<0.0001$). The mean value of edema formation after 2 months of treatment (Placebo HVPGC) was 37.2±3.44 cm which represents 2.99% reduction before treatment application value. There was a significant decreases in edema formation after two months (post treatment application) (placebo HVPGC) ($P<0.0001$) when compared with the pre treatment application value.

* 10 cm below olecranon

As observed from table (2), the mean values of edema formation at the 10 cm below olecranon level pre application, after one and two months of treatment application in the placebo HVGC group were 39.92±4.00, 38.38±4.06, and 37.90±4.13 cm respectively.

The percentage of improvement at this level of measurement after one and two months of treatment application represent 3.86% and ↓ 5.060% from pre application respectively. The statistical analysis of the mean differences of edema formation at this level provided the following result: There were significant reduction of edema formation (10 cm below olecranon) after one and two months of treatment application (placebo HVPGS).

* 5 cm below olecranon level

As shown in table (2), the mean value of edema formation in this group before application of the treatment was 40.66±3.78 cm, while after one and two months of treatment application, it were 40.15±3.76 and 39.72±3.74 cm respectively.

An initial acute drop in edema formation is noticed immediately after one and two months of treatment application when compared to the baseline value recorded before the treatment application ($P<0.0001$) and the percentages of improvement were 0.80% and ↓ 2.31% respectively.

II. Results of HVPGC group

a) Pressure threshold

As observed from table (1), the mean value of pressure threshold in the HVPGC group (pre treatment) was 5.88±0.067 Lbs/in^2, while the mean values of pressure threshold at the end of the first and second months post application of HVPGC were 7.41±0.69 and 8.91+0.72 Lbs/in^2, which represent 26.02% and 51.53% of the pre application value respectively. As shown in table (1) in the HVPGC group, there were significant increase in the pressure threshold at the end of the first and second months post application of HVPGC ($P<0.05$).

b) Edema formation (HVPGC group)

* 10 cm above olecranon level

As observed from table (3), the mean values of the edema formation at the 10 cm above olecranon level of the HVPGC group at the lymphedematous arm (pre application, after one and two months of treatment application) were (44.0±5.81, 41.90±5.75; and 40.44+5.68 cm respectively, the percentage of reductions at this level of measurement after one and two months of treatment application represent ↓ 2.77% and ↓ 8.090% from pre application respectively.

The statistical analysis of the mean differences of the edema formation provided the following result: There were significant reduction of edema formation (10 cm above olecranon) after one and two months of treatment application. Fig. (2) shows the mean values of edema formation (10 cm above olecranon level) pre and after one and two months of treatment application.

* 5 cm above olecranon level

As shown in table (3), the mean value of pre treatment application of the edema formation at the 5 cm above olecranon level of the HVPGS group was 41.73±4.99 cm, while the mean values of the edema formation of this group after one and two months of the treatment application were 39.68+4.95, and 37.29+5.02 cm respectively which indicated a significant reduction ($P<0.0001$) when compared with the corresponding values pre application. The percentage of improvement after one and two months of treatment application were ↓ 4.91% and ↓ 10.64% respectively. Fig. (3) shows the mean values of edema formation (5 cm above olecranon level) pre and after one and two months of treatment application.

* Around olecranon level

As shown in table (3), the mean value of edema formation in this group before treatment was 38.17±3.81 cm, while after one month of the treatment application, it was 36.03±3.87 cm which represents ↓ 5.60% reduction of the pre treatment value. An initial reduction in edema formation is noticed after one moth of treatment application when compared to the baseline value measured before the treatment ($P<0.0001$). The mean value of edema formation after 2 months of treatment (HVPGC) was 37.98±3.62 cm which represents ↓ 10.97% reduction when compared with before treatment application value. There was a significant decrease in edema formation after two months (post treatment application HVPGC) ($P<0.0001$) when compared with the pre treatment application value. Fig. (4) shows the mean values of edema formation (around olecranon) pre and after one and two months of treatment application of two various groups of the study.

* 10 cm below olecranon

As observed from table (3), the mean values of edema formation at the 10 cm below olecranon level pre applications, after one and two months of treatment application in the

HVPGC group were 38.15±4.15, 35.95±4.06, and 33.66±4.10 cm respectively.

The percentage of improvement at this level of measurement after one and two months of treatment application represent ↓ 5.77% and ↓ 11.75% from pre application respectively. The statistical analysis of the mean difference of edema formation at this level provided the following result: There were significant improvement in the edema size (10 cm below olecranon) after one and two month of treatment application. Fig. (5) shows the mean values of edema formation (10 cm below olecranon) pre and after one and two months of treatment application of two different groups of the study.

As shown in table (3) the mean value of edema formation in this group before application of the treatment was 35.39±4.44 cm, while after one and two months of treatment application, it were 33.22±4.58 and 31.00± 4.54 cm respectively.

An initial acute drop in edema formation is noticed immediately after one and two months of treatment application when compared to the baseline value recorded before the treatment application (P<0.0001) and the percentage of improvements were ↓ 6.13% and ↓ 12.40% respectively. Fig. (6) shows the mean values of edema formation (5 cm below olecranon) pre and after one and two months of treatment application of two different groups of the study.

* 5 cm below olecranon level

Table (l): The statistical analysis of the difference of pressure threshold on two various groups (HVPGC and placebo HVPGC).

Statistical variables	Pressure Threshold							
	Placebo HVPGC group				HVPGC group			
	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II
Mean	6.27	6.74	6.27	7.25	5.88	7.41	5.88	8.91
S.D.	0.77	0.74	0.77	0.717	0.67	0.69	0.67	0.72
S.E.	0.20	0.19	0.20	0.18	0.17	0.18	0.17	0.19
t-value	-17.27		-21.31		-1.53		-3.033	
P-value	>0.001		>0.001		<0.000		<0.000	
Level of significance	N.S.		N.S.		S		S	
% of improvement	7.5% ↑		15.63% ↑		26.02% ↑		51.53% ↑	

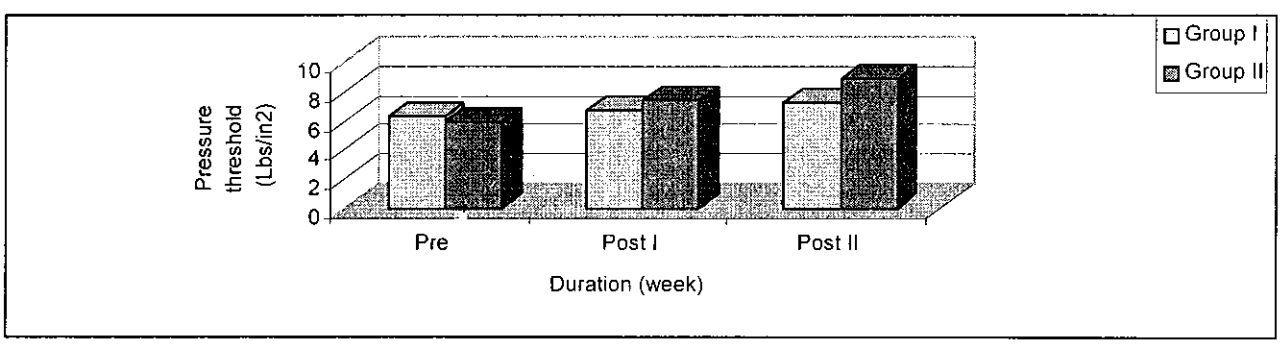

Fig. (l): The mean values of pressure threshold of two different groups in the study (HVPGC and placebo HVPGC).

Table (2): The statistical analysis of the mean differences of the edema formation (10 cm above, 5 cm above, around olecranon, 10 cm below, and 5 cm below olecranon levels) pre application and after one and two months of treatment application of placebo HVPGC group.

Statistical variables	Formation of edema (cm)																			
	10 cm above				5 cm above				around olecranon				10 cm below				5 cm below			
	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II
Mean	46.8	46.25	46.8	44.68	43.88	43.23	43.88	42.68	38.35	37.96	38.35	37.2	39.92	38.38	39.92	37.90	40.66	40.15	40.66	39.72
S.D.	6.07	6.16	6.07	5.84	4.78	4.57	4.79	4.51	3.48	3.47	3.48	3.44	4.00	4.06	4.00	4.13	3.78	3.76	3.78	3.74
S.E.	1.57	1.59	1.59	1.51	1.23	1.18	1.23	1.16	0.9	0.89	0.9	0.89	1.03	1.05	1.03	1.07	0.98	0.97	0.98	0.96
t-value	8.76		3.07		5.37		8.24		8.02		12.69		10.25		14.14		5.48		10.07	
P-value	0.0001		0.008		0.0001		0.0001		0.0001		0.0001		0.0001		0.001		0.001		0.0001	
Level of significance	S		S		S		S		S		S		S		S		S		S	
% of improvement	↓ 1.28%		↓ 4.53%		↓ 1.46%		↓ 2.73%		↓ 1.016%		↓ 2.99%		↓ 3.86%		↓ 5.060%		↓ 0.80%		↓ 2.312%	

Table (3): The statistical analysis of the mean differences of the edema formation (10 cm above, 5 cm above, around olecranon, 10 cm below, and 5 cm below olecranon levels) pre application and after one and two months of treatment application of HVPGC group.

Statistical variables	Formation of edema (cm)																			
	10 cm above				5 cm above				around olecranon				10 cm below				5 cm below			
	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II	Pre	Post I	Pre	Post II
Mean	44.0	41.90	44.0	40.44	41.73	39.68	41.73	37.29	38.17	36.03	38.17	33.98	38.15	35.95	38.15	33.66	35.39	33.22	35.39	31.00
S.D.	5.81	5.75	5.81	5.68	4.99	4.95	4.99	5.02	3.81	3.87	3.81	3.62	4.15	4.06	4.15	4.10	4.44	4.58	4.44	4.54
S.E.	1.50	1.49	1.50	1.47	1.29	1.25	1.29	1.30	0.98	0.99	0.98	0.94	1.07	1.05	1.07	1.06	1.15	1.18	1.15	1.17
t-value	25.07		15.02		30.40		18.41		20.80		29.96		25.45		41.02		29.69		37.43	
P-value	0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.001	
Level of significance	S		S		S		S		S		S		S		S		S		S	
% of improvement	↓ 2.77%		↓ 8.090%		↓ 4.91%		↓ 10.64%		↓ 5.60%		↓ 10.97%		↓ 5.77%		↓ 11.75%		↓ 6.13%		↓ 12.40%	

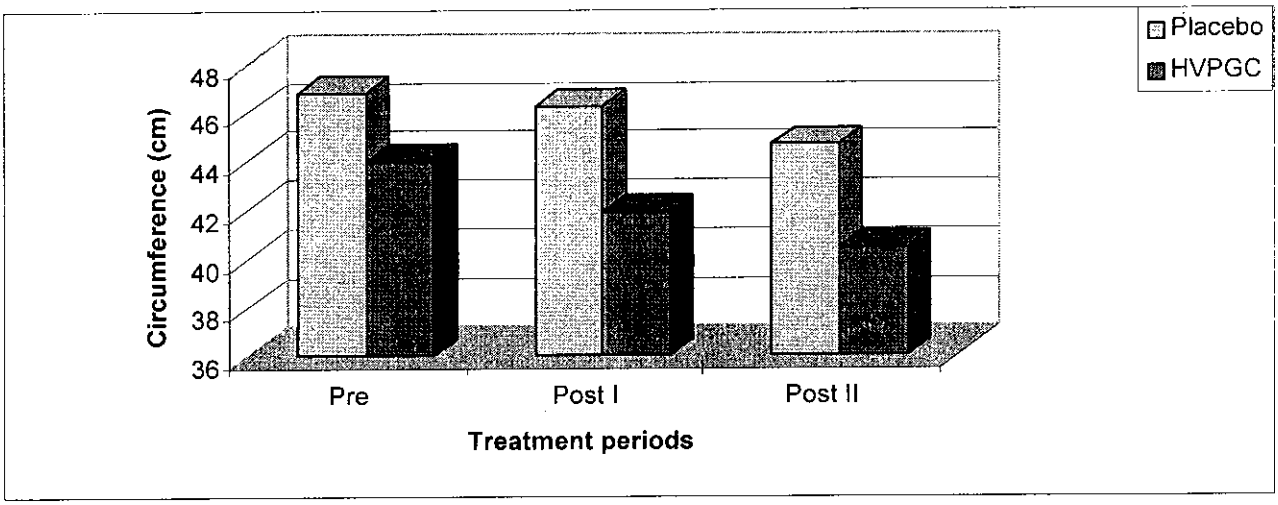

Fig. (2): The mean values of edema formation (10 cm above olecranon) pre and after one and two months of treatment application of two different groups of the study (placebo and HVPGC).

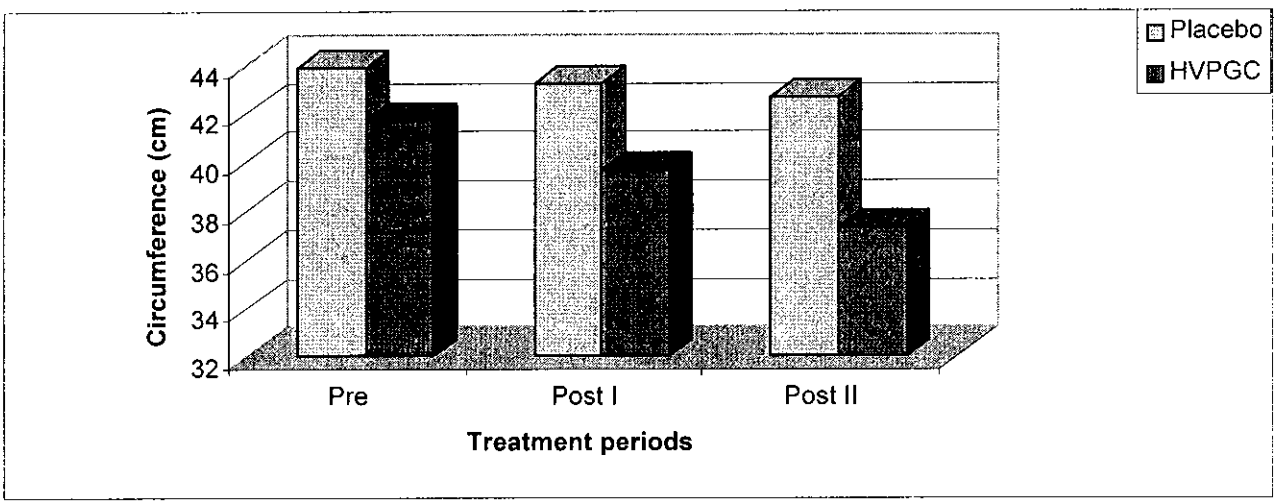

Fig. (3): The mean values of edema formation (5 cm above olecranon) pre and after one and two months of treatment application of two different groups of the study (placebo and HVPGC).

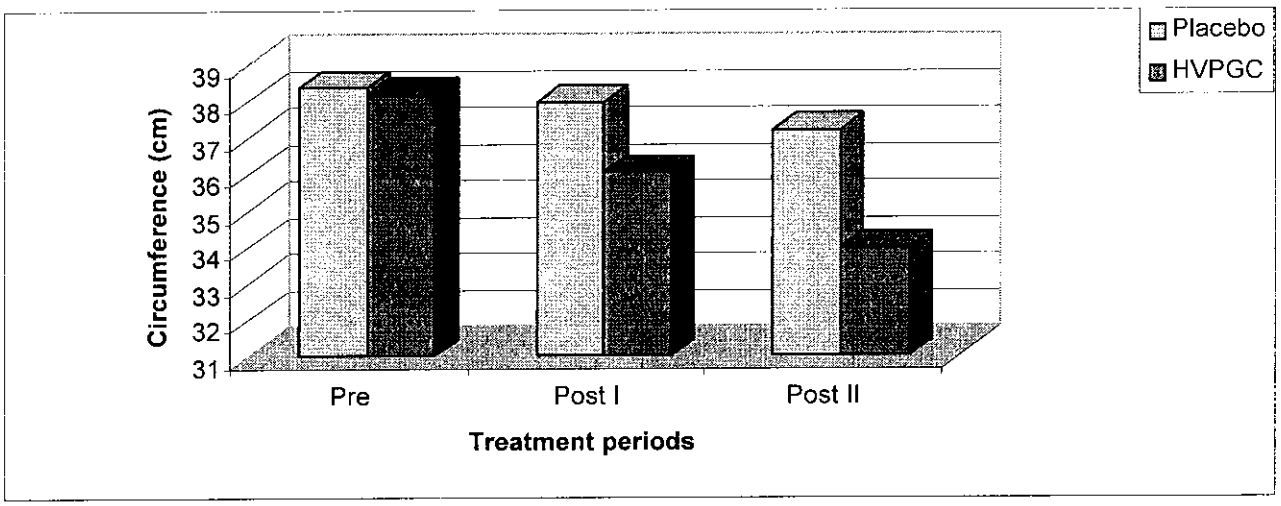

Fig. (4): The mean values of edema formation (around olecranon) pre and after one and two months of treatment application of two different groups of the study (placebo and HVPGC).

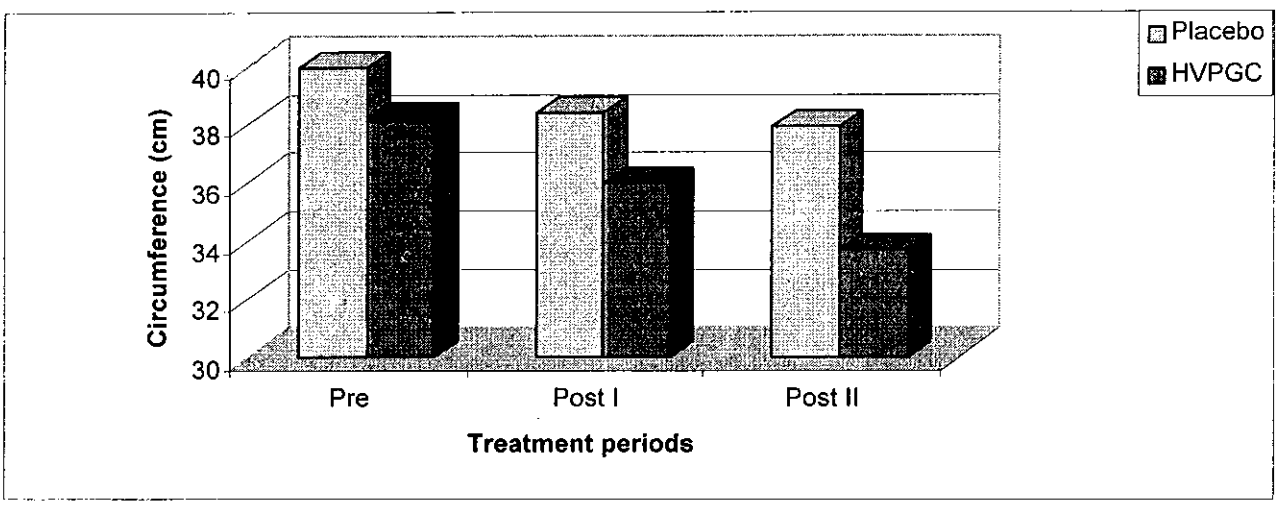

Fig. (5): The mean values of edema formation (10 cm below olecranon) pre and after one and two months of treatment application of two different groups of the study (placebo and HVPGC).

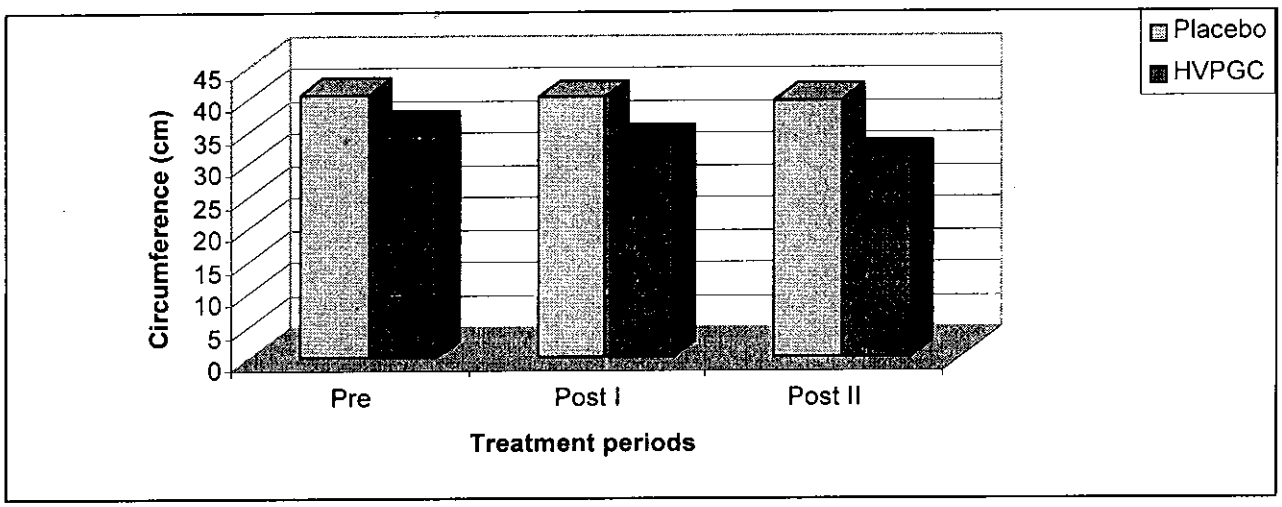

Fig. (6): The mean values of edema formation (5 cm below olecranon) pre and after one and two months of treatment application of two different groups of the study (placebo and HVPGC).

DISCUSSION

The findings of this study indicated that HVPGS has been documented as a treatment tool to reduce soft tissue edema and minimize postoperative pain in patients who have had modified radical mastectomy. The proposed rational for inclusion of HVPS was to decrease edema and pain, thus reducing the inflammatory response.

Effects of HVPGS on Pain Modulation

HVPGS improves pain tolerance postoperatively as a result of its effects on improving circulation that followed electrical stimulation through inhibition of the sympathetic nervous system result in vasodilation or through improving muscular pump. This view is supported and in agreement with some related previous researches conducted by Binder[3]; Alon[1]; Mohr et al.[11], and Tracy et al.,[19].

Binder[3] pointed out that electrical stimulation is well accepted procedure for pain control and is considered as pain relief modality postoperatively.

In addition to Alon[1] have documented that high voltage stimulation (HVS) may be effective in reducing pain,[increasing] joint mobility, improving peripheral circulation, and reducing edema of various cases.

The work of Mohr et al.,[11] also supports the view that HVS can significantly increase blood flow to the stimulated rat [hind] limb which improve blood circulation to reduce pain sensation.

Tracy et al.,[19] studied the effects of HVPC on postoperative pain. They found that application of HVPGS improve postoperative pain modulation through improving of the circulatory system and inhibition of sympathetic nervous system.

Effects of HVPGS on soft tissue edema reduction

This study showed a significant reduction in edema formation after one and two months of HVPGS application when compared with pretreatment application in

both treatment groups of the study. These differences were consistent with those reports by Michlovitz et al.,[10] Reed[15], Bettany et al.,[2] Fish et al.,[6] Mendel et al.,[9] Thornton et al.,[18] and Chu et al.,[4].

Michlovitz et al.,[10] concluded that HVPC tend to produce a decrease in foot and ankle volume and increase ROM in dorsiflexion and planterflexion in the treatment of a acute lateral ankle sprains.

Reed[15] found that HVS reduces microvessels leakiness of the plasma protein. This reduction may be due to the action of HVPS that retard edema formation in acute inflammation cases.

Chu et al.,[4] recommended that the electrical stimulation is an effective means for reduction of edema formation as it stimulates reabsorption and decrease accumulation of albumin in the damage tissues (burn injury) in rats.

Bettany et al.,[2] examined the effect of HVPC on edema formation, they confirmed that HVPC reduces edema formation after stimulated ankle sprain following impact injury (animal study). They explained that when HVPC is applied on edematous tissue, this lead to drive negative protein from interstitial spaces into lymphatic channels which reduce edema formation.

Fish et al.,[6] studied the effect of HVPC on edema formation, cathodal HVPC has repeatedly been shown to significantly curb edema formation in frogs after mechanical injuries whereas anodal HVPC did not curb edema formation. They concluded that in the context of using HVPC at intensity 10% less than visible motor threshold for edema control, polarity of electrical stimulation is an important variable.

Mendel et al.,[9] found that the volumes of treated limb were significantly less than volumes of untreated limbs after hyperflexion injury in progs (post traumatic edema) (animal study), therefore, the results of this study proved the rational for efficacy of cathodal HVPGC in inhibiting edema formation.

Some physiological mechanisms have been postulated to prove the effects of HVPGS on reduction of the amount of lymphoedema.

One possible explanation of the effects of HVPGS on edema reduction is that negatively charged current reples the negatively charged protein and prevent their movements into the intersitum (charge repulsion theory = Electrical Flied Mechanism).

This hypothesis stated that the charged current repels and forces migration of charged serum protein mainly albumin that accumulate in the interstitial as a result of edema and prevent their leakage from vascular to extravascular space[13,14].

Another concept of logical explanation about HVPGS action on edema reduction is electrically stimulated muscle pumping. The increased interstitial by hydrostatic pressure caused by skeletal muscle contraction or pump may facilitate fluid reabsorption and the increased pressure gradient to the right atrium enhances venous return[15].

The commonest scientific explanation is that HVPGS reduces microvessels permeability to plasma protein, this limiting further development of preexisting edema (Microvascular permeability mechanism). HVPGS may cause contraction that lead to compression and squeezing of venous and lymphatic vessels, this repetitive contraction presumably induced increase venous and lymphatic return as well as increased interstitial hydrostatic pressure. These activities may promote reabsorption leakage fluid and protein with subsequent edema reduction.

So these significant reduction in the size of edema confirmed by increase pressure threshold after HVPGS application for one or two months may be in part due to one of those previous explanations.

From previous discussion of these findings and according to some studies of researchers and investigators in fields related to the present study, it can be claimed that there is a reduction in the size of arm lymphoedema and modulation in the amount of pain after application of high voltage pulsed galvanic current with post mastectomy lymphoedema cases.

CONCLUSION

As a conclusion, HVPGS appears to be an effective method of physical therapy helping the patients who had modified radical mastectomy to control pain and formation of lymphoedema after breast surgery.

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الملخص العربي

تأثير التيار الجلفانى المتقطع العالي الجهد على تحكم الألم والورم في حالات الورم الليمفاوي بعد استئصال الثدي

الهدف من البحث :

يهدف هذا البحث لدراسة تأثير التيار الجلفانى المتقطع عالي الجهد على تحسن العمل الوظيفي للطرف العلوي من خلال تقليل كمية الورم والتحكم في الآلام الناتجة من إجراء عملية استئصال الثدي .

مواد وأساليب البحث :

تـم إجـراء تـلك الدراسة على ثلاثين امرأة ممن تم استئصال الثدي لهم وقد تراوحت أعمارهم ما بين 35 ، 55 سنة وقد قسمت عشـوائياً إلى مجموعتين: المجموعة الأولى: وهى المجموعة التي تتلقى العلاج الكاذب الغير مؤذى والتيار الجلفانى المتقطع العالي الجهد بجانب تلقى العلاج التقليدي لحالات ما بعد الجراحة وعددهم خمسة عشر مريضة.

أمـا المجموعـة الثانية وعددها خمسة عشر مريضة مم تم علاجهم بوسائل العلاج الطبيعي التقليدية ولكن بإضافة استخدام التيار الجلفانى العالي المتقطع الجهد لمدة ثلاثون دقيقة يوم بعد يوم لمدة شهر ثم يستمر العلاج لمدة شهرين .

وقد تم قياس معدل الألم بطريقة Fischer (1994) وكمية الورم بطريقة Wingate 1985 لتلك المجموعتين قبل أداء العلاج وبعد أداء العلاج بشهر ثم شهرين.

نتائج البحث :

قد أظهرت نتائج هذه الدراسة ما يأتي :

أن هـناك زيـادة واضحة في معدل الضغط على أماكن الألم وتقليل كمية الورم الناتج بعد العملية على الطرف العلوي تجاه مكان الاستئصال بعد استعمال العلاج التقليدي مضاف إليه التيار الجلفانى المتقطع العالي الجهد وقد تم مناقشة التفسيرات المتحملة لتلك النتائج.

ويمكن استنباط الآتي :

أن اسـتخدام الـتيار الجلفانى العالي الجهد مع العلاج التقليدي لحالات ما بعد الجراحة استئصال الثدي أدى إلى تقليل كمية الورم والألم الناتج من العملية الجراحية مما يكون له أكبر الأثر في زيادة الكفاءة الوظيفية للطرف العلوي المصاب.