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Effect of Neuromuscular Electrical Stimulation on Varicose Veins in Postpartum Women

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Abstract

Background: Varicose Veins (VVs) is one of the commonest problems of women during pregnancy and postpartumperiods. Pregnancy has a vasodilatation effect on the veins of the lower limbs, after labor this effect should be reversed and veins return to normal, but in some cases it lasts further in the postpartum period and requires treatment.

Aim of Study: The purpose ofthis study was to investigate the effect of Neuromuscular Electrical Stimulation (NMES) on varicose veins in postpartum women.

Material and Methods: Thirty post-partum women complaining from varicose veins participated in this study. They were randomly distributed in two equal groups; Group A (control group): 15 women received a life style modification and advices and Group B (study group): 15 women received a life style modification and advices in addition to neuromuscular electrical stimulation therapy 3 sessions per week for 4 weeks. Doppler ultrasound device for recording peak popliteal vein velocity and the Chronic Venous Disease Quality of Life Questionnaire (CIVIQ-20) for quality of lifewere used for assessment before and after treatment period.

Results: Results showed that there was no significant difference in group A (control group) when comparing pretreatment to post-treatment results regarding the popliteal peak vein velocity while there was a significant reduction regarding quality of life questionnaire CIVIQ-20, and when comparing pre-treatment to post-treatment results in group (B) (study group) there was significant increase regarding the popliteal peak vein velocity and a significant reduction regarding the quality of life questionnaire CIVIQ-20. In addition there was no statistical significant difference between both groups regarding the popliteal peak vein velocity and quality of life questionnaire CIVIQ-20 when comparing post-treatment results, results also revealed that there was clinical difference and high percent of improvement in favor of group B (study group) than group A (control group) regarding both popliteal peak velocity and quality of life questionnaire CIVIQ-20.

Conclusion: It can be concluded that (NMES) has an effect on increasing venous blood flow and improving quality of life in postpartum women with varicose veins.

Key Words: *Varicose veins – Neuromuscular electrical stimulation – Postpartum.*

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Introduction

DURING pregnancy, various anatomical and physiological changes occur to the pregnant women **[1]**. Pregnancy is considered to be a major contributory factor in the increased incidence of varicose veins in women, which can in turn lead to venous insufficiency **[2]**, approximately 15 to 20 per cent of pregnant women develop varicose veins **[3]**.

The venous system can be divided into three major components; the superficial venous system, the deep venous system, and perforating veins **[4]**, venous valves exist in many veins, both small and large, that conduct blood flow against the gravity; these valves prevent the backflow of blood from the heart to the lower limbs **[5]**. In the upright position gravity pulls the blood downwards to the lower limbs, body mechanisms such as vasoconstriction and valves of the veins assist in pumping blood upwards **[6]**. The calf muscle pump is the primary mechanism to returnblood from the lower limbs to the heart; theyexpel more than 60% of venous blood into the large popliteal vein **[7]**.

Varicose veins are dilated, often palpable subcutaneous veins with reversed blood flow, most commonly found in the legs **[8]**, several theories explained the developing of varicose disease during pregnancy among these theories is the compression of the enlarged uterus on pelvic and iliac veins **[9]**, the hormonal changes that cause the relaxing effect on the smooth muscle also could result in varicose veins **[10]**, Hypervolemia of the blood may be

among other theories of developing varicose veins **[11].**

According to the Clinical Etiological Anatomical Pathophysiological (CEAP) classification of varicose veins; varicose veins in pregnant women are mostly with CEAP classification of C1 and C2 **[9].**

Duplex Ultrasonography (Duplex US) is a widely accepted method ofevaluating varicose vein disease in the legs **[12],** chronic venous disease quality of life questionnaire CIVIQ-20 is able to assess the impact of varicose veins on patients' lives **[13].**

Treatment of varicose veins include conservative management, external laser treatment, injection sclerotherapy, endovenous interventions, and surgery, the choice of treatment depends on the patient preference, cost severity of the symptoms and potential for complications to occur **[14].**

Neuromuscular electrical stimulation has shown to be a safe, well tolerated modality that increases venous blood flow parameters by artificially activating the muscle pumps of the lower limb **[15].**

Aim of the work:

The present study was conducted to investigate the effect of NMES on varicose veins in postpartum women and clarify its effect as a method of treatment in this condition.

Patients and Methods

The current study was conducted at El-Menshawy General Hospital in Tanta City, Gharbia, Egypt from June 2019 to December 2019, the study was approved by Research Ethical Committee of Faculty of Physical Therapy, Cairo University, in May 2018 (No: P.T. REC/012/001972).

Thirty postpartum females complaining from varicose veins participated in this study their ages were ranged from 20 to 35 years and their body mass index were ≤30kg/m^2. These patients were randomly distributed by closed envelope method into two equal groups. Group A (control): It consists of fifteen patients received a program of life style modifications and advices for 4 weeks, Group B (study): It consists of fifteen patients received program of life style modifications and advices in addition to neuromuscular electrical stimulation sessions 3 times per week for 4 weeks.

Inclusion criteria:

Postpartum women with varicose veins that last 1-2 years since the last pregnancy, their CEAP classification of varicose veins was C0-C1, all the participants had almost the same life style and ADL routine.

Exclusion criteria:

Women were excluded from this study if they had history of serious vascular disease as Deep Venous Thrombosis (DVT), pacemaker, sensory deficient or any dermatological condition that interfere with the procedure.

All participants were given a full explanation of assessment procedures and treatment procedures, and informed consent form had been signed before participating in the study.

All patients were subjected to the following:

I- Full history taking: Including personal history, medical history and obstetric history at the beginning of this study.

II- Weight and height measuring for assessment of Body Mass Index (BMI).

III- Assessment of daily life activity by filling out chronic venous disease quality of life questionnaire (CIVIQ-20) form before and after treatment.

IV- Doppler ultrasounds scan using a GE logic7 ultrasound device for measuring the peak popliteal vein velocity in centimeters per second (cm/sec) by same radiologist with the patient in supine lying position with the measured leg in flexion external rotation, the angle of insonation of the ultrasound scan beam with the vein was 60 degrees. All measurements were repeated three times, and the mean was used for analysisbefore and after treatment procedures.

Therapeutic procedure:

Participants in both groups A and B received the same conservative treatment program and instructions.

1- *Group (A) (control group):* Consisted of 15 postpartum women they received conservative treatment program which includes positioning, leg exercise and advices.

2- *Group B (study group):* Consist of 15 patients, they received the same conservative treatment program in addition to neuromuscular electrical stimulation sessions on the calf muscle using amulti currents generator (Etuis, SN-36/N1/AO VER 2.0) with frequency ranged from 30-50Hz, pulse width 150-200μs, intensity according to the patient tolerance and time of session was 30 minutes. Number of session was 12 sessions one every other day for 4 weeks.

Patient preparation:

Patient was placed in comfortable supine lying position with head supported on small pillow; both arms were extended beside the body. The patient was covered with a sheet during treatment session and the device was prepared to be applied.

Statistical analysis:

Statistical analysis was conducted using SPSS for windows, version 23 (SPSS, Inc., Chicago, IL). The quantitative data were presented as mean, standard deviations and ranges when parametric. Also qualitative variables were presented as number and percentages. So, the *p*-value was considered significant as the following: *p*-value >0.05: Non Significant (NS), *p*-value <5 Significant (S), *p*-value <0.01 Highly Significant (HS).

Results

Table (1) showed that, there were no significant differences ($p>0.05$) in the mean values of age, body mass, height and BMI between both tested groups.

Table (1): Physical characteristics of participants in both groups (A & B).

Items	Group A Mean ± SD	Group B Mean ± SD	Comparison		S
			t-value	*p*-value	
Age (years)	30.93±2.86	30.4±3.58	0.45	0.656	NS
Body mass (Kg)	71.26±9.88	73±9.37	–0.493	0.626	NS
Height (cm)	166±6.08	164.26±5.13	0.843	0.406	NS
BMI (kg/m^2)	25.84±3.22	26.97±2.42	–1.084	0.288	NS

*SD : Standard Deviation. NS: Non-Significant.
p : Probability. * : Significant at alpha level <0.05.
S : Significance.

Table (2): Mean ± SD and *p*-values of peak popliteal vein pre and post-test at both groups.

Peak popliteal vein	Pre test Mean ± SD	Post test Mean ± SD	MD	% of change	*p*-value
Group A	14.62±3.31	14.42±2.74	0.2	1.36	0.784
Group B	13.06±3.41	14.82±3.27	–1.75	13.39	0.02*
MD	1.55	–0.4			
p-value	0.217	0.724			

* : Significant level is set at alpha level <0.05.
SD : Standard Deviation.
MD : Mean Difference.
p-value : Probability value.

Peak popliteal vein velocity:

1- *Within groups:*

Table (2) showed that in group (A) (control group) there was no significant difference of peak popliteal vein velocity at post-treatment in compare to pre-treatment (*p*-value=0.784), while there was significant increase of peak popliteal vein velocity at post-treatment in compare to pre-treatment (*p*-value=0.02*) in group (B) (study group).

2- *Between groups:*

Table (2) illustrated that that there was no significant difference of the mean values of the "post" test between both groups with ($p=0.724$). In spite of there was no statistical significant difference, there was clinical difference and high percent of improvement in favour to group B (study group) (13.39%) than group A (control group) (1.36%).

Table (3): Mean ± SD and *p*-values of CIVIQ-20 questionnaire pre and post-test at both groups.

CIVIQ-20 questionnaire	Pre test Mean ± SD	Post test Mean ± SD	MD	% of change	*p*-value
Group A	46.8±19.86	39±12.65	7.8	16.66	0.007*
Group B	50.2±14.39	39.6±11.08	10.6	21.11	0.0001*
MD	–3.4	–0.6			
p-value	0.596	0.891			

* : Significant level is set at alpha level <0.05.
SD : Standard Deviation.
MD : Mean Difference.
p-value : Probability value.

CIVIQ-20 questionnaire:

1- Within groups:

Table (3) showed thatin group (A) (control group) there was significant reduction of CIVIQ-20 questionnaire at post-treatment in compare to pre-treatment (*p*-value=0.007*), while there was significant reduction of CIVIQ-20 questionnaire at post-treatment in compare to pre-treatment (*p*-value=0.0001*) in group (B) (study group).

2- Between groups:

Table (3) illustrated that there was no significant difference of the mean values of the "post" test between both groups with ($p=0.891$). In spite of there was no statistical significant difference, there was clinical difference and high percent of improvement in favour to group B (study group) (21.11%) than group A (control group) (16.66%).

Discussion

Varicose veins can be associated with serious complications as chronic venous insufficiency and deep venous thrombosis DVT. Early treatment of varicose veins may reverse the symptoms of venous congestion and minimize the risk of varicose vein related complications and further progression of the disease **[16]**. Calf muscle pump activity is the motive force that significantly affects venous circulation in the lower extremity **[17]**. Neuromuscular Electrical Stimulation (NMES), have been used to

enhance venous hemodynamics via motor nerves or via skeletal muscles **[19]**.

Results showed that there was no significant difference in group A (control group) when comparing pre-treatment to post-treatment results regarding the popliteal peak vein velocity while there was a significant reduction regarding quality of life questionnaire CIVIQ-20, and when comparing pre-treatment to post-treatment results, while in group (B) (study group) there was a significant increase regarding the popliteal peak vein velocity and a significant reduction regarding the quality of life questionnaire CIVIQ-20. In addition there was no statistical significant difference between both groups regarding the popliteal peak vein velocity and quality of life questionnaire CIVIQ-20 when comparing post treatment results, results also revealed that there was a clinical difference and high percent of improvement in favor of group B (study group) than group A (control group) regarding both popliteal peak velocity and quality of life questionnaire CIVIQ-20.

These findingscould be explained by Guo et al., **[19]** who reported that conservative treatment of varicose veins can temporarily relieve pain. However, in the long term, the conservative treatment methods for patients with varicose veins of lower extremity are not very effective.

These finding also were in agreement with those of Corely et al., **[20]** that by contracting the calf muscle passively through the NMES, the blood flow in the deep veins increase as a response of contraction and also were in agreement with Griffen et al., **[21]** that neuromuscular electro-stimulation has been shown to be an effective method of increasing flow in the axial deep veins of the calf and significant increases in velocity and volume flow in response to the electrical stimulus were seen in popliteal vein and other two veins studied. In addition these findings were consistent with Bogachev et al., **[22]** that applying NMES on patient with venous disorders resulted in a significant reduction in CIVIO-20 questionnaire and improving in symptoms.

These results could be illustrated by Williams **[23]** in a similar study reported that using NMES device caused mean increases in venous parameters (peak venous velocity-time averaged maximum velocity).

The lack of statistical significant difference between both groups (A) and (B) when comparing post-treatment results can be explained by the sample size which may consider relatively small sample size so that the difference could not berepresented statistically.

Also the findings of the current study were in agreement with the conclusions of Ravikumar et al., **[24]** about the promising role for NMES in managing patients with venous diseases, in particular to improve quality of life outcome measures, in spite of that the findings of the current study does not agree with Ravikumar et al., **[24]** about that the effect of NMES on venous flow parameters is transient, limited to the duration of device usage cause according to the current study the NMES's effect on the blood flow was not transient and limited to device usage but it showed an accumulating effect after the treatment period.

Conclusion:

In conclusion, Neuromuscular Electrical Stimulation (NMES) can increase peak popliteal vein velocity, improve blood flow and assist in improving symptoms and quality of life in women with postpartum varicose veins and it emphasizes clinically the promising potential of Neuromuscular Electrical Stimulation (NMES) as an innovative, noninvasive and non-expensive method that can be used as a new physical therapy modality in the treatment of varicose veins in postpartum women.

Conflicts of interests:

All authors disclose no financial or personal relationships with other people or organization that could influence the research's results.

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تآثير التنبيه العصبى العضلى الكهربائى على دوالى الساقين لدى السيدات فى فترة ما بعد الولاده

آجريت هذه الدراسة لمعرفة تآثير التحفيز الكهربائى العصبى العضلى على دوالى الساقين عند السيدات بعد الولادة. شاركت فى هذه الدراسة ثلاثون سيدة مصابه بدوالى الساقين من الدرجة الآولى آو الثانية الناتجة عن الحمل آثناء فترة ما بعد الولادة، تراوحت آعمارهن من ٢٠-٣٥ سنه وكان مؤشر كتلة الجسم من ٢٠-٣٠كجم/م^{2}. تم تقسيمهن إلى مجموعتين متساويتين (آ) و (ب)، تلقت المجموعة (آ) (المجموعة الضابطة) برنامج علاج تحفظى ونصائح لتعديل نمط الحياة بينما تلقت المجموعة (ب) (مجموعة الدراسة) نفس برنامج العلاج التحفظى والنصائح كما فى المجموعة (آ) بالإضافة إلى التنبيه العصبى العضلى الكهربائى لعضلة الساق الخلفية ثلاث جلسات إسبوعياً لمده آربع آسابيع، تم إستخدام جهاز الموجات الفوق صوتية دوبلر لقياس تدفق الدم الوريدى فى الوريد المآبضى بالإضافة إلى إستبيان جوده الحياه للآمراض الوريدية المزمنة لتقييم كفاءه آنشطة الحياه اليومية لكل السيدات فى كل المجموعتين قبل وبعد فتره العلاج.

آظهرت النتائج عند مقارنة القياسات فى المجموعة (آ) المجموعة الضابطة ما قبل وبعد فترة العلاج آنه لم يكن هناك فارق ذو دلالة إحصائية عالية فى السرعة الوريدية للوريد المآبضى بينما كان هناك إنخفاض ذو دلالة إحصائية عالية فى إستبيان جوده الحياه، آما عند مقارنة النتائج ما قبل وبعد فترة العلاج فى المجموعة (ب) مجموعة الدراسة كان هناك فارق ذو دلالة إحصائية عالية فى ما يخص كلا من المتغيرين السرعة الوريدية للوريد المآبضى وإستبيان جوده الحياه وعلى الرغم من عدم وجود فارق ذو دلالة إحصائية عالية عند المقارنة بين المجموعتين (آ و ب) إلا آن النتائج آوضحت إختلاف سريرى ونسبه تحسن مئوية عالية لصالح المجموعة (ب) (مجموعة الدراسة) عن المجموعة (آ) (المجموعة الضابطة) فى ما يتعلق بالسرعة الوريدية وإستبيان جودة الحياة CIVIQ-20 بعد إنتهاء مده العلاج، لذلك يمكن إستنتاج آن التنبيه العصبى العضلى الكهربائى له تآثير فعال على زيادة تدفق الدم وتحسين نوعية الحياه للسيدات اللاتى تعانين من دوالى الساقين ما بعد الولاده.