Med. J. Cairo Univ., Vol. 92, No. 4, Accepted 8/7/2024
DOI: 10.22608/MJCU. 989-995, December 2024
www.medicaljournalofcairouniversity.net

Effect of Acupuncture Like Tens and Diaphragmatic Breathing Exercises on Blood Pressure in Women with Preeclampsia

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Abstract

Background: Preeclampsia is a complication of pregnancy. With preeclampsia, the pregnant mother might have high blood pressure, high levels of protein in urine that indicate kidney damage (proteinuria), or other signs of organ damage. Preeclampsia usually begins after 20 weeks of pregnancy in women whose blood pressure previously been in the standard range. Preeclampsia can lead to serious-even-fatal-complications for both the mother and baby. Early delivery of the baby is often recommended. The timing of delivery depends on how severe the preeclampsia is and how many weeks pregnant you are. Before delivery preeclampsia treatment include careful monitoring and medications to lower blood pressure and mange complications. Using transcutaneous electrical nerve stimulation (TENS) to stimulate specific acupuncture points has a great efficacy to lower blood pressure. Also, deep breathing exercises is a type of relaxation techniques that assist in lowering blood pressure and reducing symptoms of preeclampsia.

Aim of Study: This study was conducted to investigate the effect of the acupuncture like TENS and diaphragmatic breathing exercises on blood pressure in women with preeclampsia.

Patients and Methods: This study was carried out on Forty pregnant women in third trimester, suffered from mild preeclampsia. Their (SBP) was ranging between (140-159) mmHg and their (DBP) was ranging from (90-99) mmHg. They were selected randomly from the outpatient clinic of obstetrics and gynecology at Zagazig Hospital. Their ages were ranged from (25-35) years old, their body mass index (BMI) didn't exceed 30kg/m^2 and their parity was ranged from (0-3) children. All patients were divided randomly into 2 groups equal in number as study group (group A) and control group (group B). Study group (A): This group was consisted of 20 patients. Each patient in this group had received transcutaneous electrical nerve stimulation (TENS) with frequency 2Hz and pulse width 200μs on bilateral acupoints (LI4), (LI11), (ST36) and (LR3) that were presented in upper & lower extremities for 30 minutes, 3 times/week till the end of pregnancy. Also, each patient was asked to perform deep breathing exercises for 20 minutes, 3 times/week till the end of pregnancy. Additionally to this, each patient was asked to take her medical treatment (antihypertensive drugs) and to follow with her doctor continuously until the date of delivery. Control group (B): This group was consisted of 20 patients. Each patient in this group was asked to perform deep breathing exercises for 20 minutes, 3 times/week till the end of pregnancy and take her medical treatment (antihypertensive drugs) and to follow with her doctor continuously till the date of delivery.

Results: The results of this study revealed that, both groups (A) and (B) showed statically (*p*-value <0.001) significant decrease in systolic and diastolic blood pressure after treatment. Group (A) achieved a percentage of decrease in systolic BP 18.98% and a percentage of decrease in diastolic BP about 16.30%. While group (B) achieved a percentage of decrease in systolic BP 4.8% and a percentage of decrease in diastolic BP 4.25%. By comparing the two groups (A & B) before and after treatment course, it was found that, percentage of decrease in systolic and diastolic BP in group (A) was more pronounced and more noticeable when compared with group (B).

Conclusion: It could be concluded that acupuncture like TENS and diaphragmatic breathing exercises had a beneficial effect in lowering blood pressure in women with preeclampsia.

Key Words: *Preeclampsia – Blood pressure – Antihypertensive drugs – TENS on acupoints – Breathing exercises.*

Introduction

PREECLAMPSIA (PE) is defined as new-onset hypertension that develops in pregnancy, most often after 20 weeks of gestation. PE is often accompanied by new-onset proteinuria, although PE can also present without proteinuria **[1].**

If proteinuria is not present, PE is diagnosed when gestational hypertension occurs in association with the following severe features: Thrombocytopenia; impaired liver function as indicated by twice the normal concentration of blood levels of liver transaminases **[2].**

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Persistent upper right quadrant pain; a rise in serum creatine; pulmonary edema; new-onset headache that cannot be excluded by other diagnoses and does not respond to medication; and/or visual disturbances [3].

The global incidence of preeclampsia appears to be increasing, most likely due to advancing maternal age, the higher prevalence of obesity and medical comorbidities, and the use of assisted reproductive techniques [4].

Women with preeclampsia are at risk of various complications including eclampsia, renal failure, placental abruption, and preterm birth in the peripartum period [5].

The exact etiology of PE remains elusive, but several theories were proposed. A noteworthy hypothesis postulated that preeclampsia originates from placental dysfunction. It seems likely that prohypertensive factors are released into the circulation as a response to diminished adaptive capability of the vasculature in the uteroplacental unit, placental ischemia, and reperfusion [6].

The placenta is the central organ in the pathogenesis of preeclampsia. Preeclampsia only occurs in the presence of a placenta and almost always remits after its delivery [7].

Antihypertensive drugs were found to increase uterine muscle tone causing IUG which resulted in neonatal respiratory depression, bradycardia and hypoglycemia [8].

Additionally, they cause maternal lethargy, drowsiness, depression, headaches, palpitation, tachycardia, drug induced hepatitis and ability to cause a rapid fall in blood pressure. So, interest has increased not only in drug treatment but also, in non-pharmacological approaches [9].

It has been shown that acupuncture is an effective way to lower blood pressure. As a non-invasive treatment, TEAS is similar to acupuncture in stimulating acupoints, and many clinical studies have shown the feasibility and safety of TEAS [10].

Transcutaneous electrical acupoint stimulation (TEAS) is a non-invasiveness alternative therapy to electro-acupuncture and manual acupuncture [11].

It is used to induce the acupoints by using transcutaneous electrical nerve stimulation (TENS) instead of needles, given it an advantage of a very simple method to be learned without any adverse effects associated with traditional acupuncture such as infections or punctures of the internal organs [12].

TEAS is possibly affecting the blood pressure by protecting the myocardial tissues and influencing the nervous system through regulating the autonomic nervous system function and reduction in sympathetic activity [12].

In a study, Jacobsson et al., found that TEAS may have additional antihypertensive effect on 24-h ambulatory BP in those patients who did not respond to pharmacological treatment [13].

Breathing method which composed of thirty minutes program including abdominal deep breathing and mental concentration was an effective behavioral therapy to reduce blood pressure of the client with essential hypertension [14].

Patients and Methods

This study was carried out on Forty pregnant women in third trimester, suffered from mild preeclampsia. Their (SBP) was ranging between (140-159)mmHg and their (DBP) was ranging from (90-99)mmHg. They were selected randomly from the outpatient clinic of Obstetrics and Gynecology at Zagazig Hospital. This study had lasted 12 months from June 2023 to June 2024. Their ages were ranged from (25-35) years old, their body mass index (BMI) didn't exceed 30kg/m^2 and their parity was ranged from (0-3) children.

Table (1): Illustrates demographic features (general characteristics) of the two studied groups.

Variables	Group A (n=20)	Group B (n=20)	*t*-value	*p*-value
Age (yrs.)	31.20±2.53	30.65±2.50	0.692	0.493
Weight (kg.)	80.40±5.42	80.30±6.25	0.054	0.957
Height (cm)	169.25±5.50	168.50±5.93	0.415	0.681
BMI (kg/m^2)	28.06±1.18	28.25±0.83	–0.590	0.559

Data are expressed as mean ± SD.
NS = p>0.05 = Not significant.

Material:

1- *Consent form:* Each patient in both groups (A & B) was asked to sign on the consent form before starting the treatment course.

2- *Recording data sheet:* All data of each patient in both groups (A&B) was taken and recorded in data sheet. It was including: Name, age, address, occupation, diagnosis, chief complain, past and present history, Obstetric & Gynecological history & family history.

3- *Weight-height scale:* It was used to measure weight and height of each patient in both groups (A&B) before starting the treatment course to calculate BMI through this equation:

BMI = Weight (Kg) / Square of body height (m^2) = kg/m^2.

4- *Transcutaneous Electrical Nerve Stimulation (TENS):* (mode EV-906, made in Taiwan): TENS unit was used to treat all patients in study group (group A).

5- Mercury sphygmomanometer device & stethoscope: It was used to measure the arterial blood pressure of each patient in both groups (A&B) before and after the treatment course.

6- Plinth, white sheet, an arm chair, cotton, a bottle of alcohol.

7- Stop watch: It was used to determine time of each treatment session.

Methods:

A- *Evaluating procedures:*

1- All data of each patient in both groups (A&B) were taken and recorded in data sheet before starting the treatment course.

2- Weight and height of each patient in both groups (A&B) were measured before starting the treatment course and BMI was calculated.

3- The arterial blood pressure of each patient in both groups (A&B) was measured before and after the treatment course. In the same time, each patient in both groups was advised to measure and check her blood pressure daily using the automated device and if she noticed any elevation in her arterial blood pressure she should immediately visit her doctor.

The blood pressure test was done in the following steps:

Each patient in both groups (A&B) were asked to roll up her sleeve of her right hand then was lying in a comfortable relaxed position on the plinth and rest her right arm on the plinth so, her arm was at the level with her heart.

A- After that, the physio therapist was wrapped the blood pressure cuff around her upper arm with the bottom edge placed just above her elbow and place a stethoscope over the major artery in her upper arm to listen to blood flow and pulse as the cuff was inflated and deflated.

B- Then, the physio therapist was inflated the blood pressure cuff using the small hand pump. After that, she opened the valve on the cuff to slowly released air from it. As the pressure falls, a measurement was taken when the sound of blood pulsing is first heard. This was the systolic pressure.

C- As the air continued to be let out, blood pulsing sound was started to go away. When it completely stops, another measurement was taken. This was the diastolic pressure.

D- This procedure was repeated 3 times, in each time the physio therapist took the measurement of arterial blood pressure, after that, the physio therapist took the mean of three measurements.

E- Each patient in both groups (A&B) were asked to collect a 24 hours urine sample and sent it to the laboratory center to measure proteinuria level in urine. This was done before and after the treatment course.

B- *Treatment procedure:*

Study group (Group A):

This group was consisted of 20 patients. Each patient in this group had received transcutaneous electrical nerve stimulation (TENS) with frequency 2Hz and pulse width 200μs on bilateral acupoints (LI4), (LR3), (ST36), and (LI11) that were presented in upper & lower extremities for 30 minutes, 3 times per week till the end of pregnancy *[15]*.

Also, each patient was asked to perform deep breathing exercises for 20 minutes, 3 time/week till the end of pregnancy. Additionally to this, each patient was asked to take her medical treatment (antihypertensive drugs) and follow with her doctor continuously until the date of delivery.

The treatment session was done in the following steps:

1- Each patient was asked to lie on the plinth, in crock lying position, rested her forearm, hands and feet on the plinth and both elbows were flexed at 90 degree. Then, the patient was covered with a white sheet except the treated area.

2- Then, bilateral 4 acupoints that were presented bilaterally in upper & lower extremities were detected and remarkable by a pen marker as the following:

- LI11 acupoint is located in the depression of the lateral end of the transverse cubital creases when the elbow is flexed at a right angle (nearly on the lateral aspect of the elbow, on lateral epicondyle of the humerus) *[16]*.
- LI4 acupoint is located on the dorsum surface of the hand,in the middle of the 2nd metacarpal bone on the radial side *[17]*.
- ST36 acupoint is located on the anterior aspect of the leg about 3 cun below the lower border of the patella, 1 finger breadth lateral to the anterior crest of the tibia on the tibialis anterior muscle *[18]*.
- LR3 acupoint is located on the dorsum surface of the foot, in the depression anterior to the junction of first and second metatarsal bones *[19]*.

3- After that the skin over these acupoints was cleaned with a piece of cotton immersed in alcohol to decreased skin resistance. Then, four adhesive rubber electrodes of TENS device were placed on bilateral 4 acupoints that were presented in right upper limb and in right lower limb, TENS device was adjusted on the following parameters:

- Frequency: 2 Hz.
- Pulse width :200 μs.
- Intensity: According to patients' tolerance.
- Duration: 15 minutes.

4- After calibrating TENS device, the physiotherapist switched on the TENS device for 15 minutes. After that, the device was switched off and

4 adhesive rubber electrodes were removed and placed on another 4 acupoints that were presented on left upper limb and left lower limb in the same manner, then TENS device was adjusted on the same parameters and switched on for another 15 minutes.

At the end, (TENS) device was switched off and four rubber electrodes were removed.

5- After that, the patient was asked to perform deep breathing exercises for 20 minutes. This procedure was done 3 times/week till the end of pregnancy as the following:

Deep breathing procedures:

There are 2 types of breathing exercises: Lateral costal breathing and diaphragmatic breathing exercises.

a- Lateral costal breathing exercises:

Position of the patient: Each patient was asked to lie in crock lying position and the patient was asked to deviate her head to the other side.

Position of the therapist: Stride standing beside the mother and the therapists hands on lateral aspect of the patients chest making abduction in her fingers and hold the lateral aspects of the patients chest.

Command: Each patient was asked to take deep breathing from her nose push the physiotherapist hands outwards then expire the air from her mouth and relax. This procedure was repeated 3 times then take a rest for 3 minutes and repeat the same exercise again in the same mannar for 10 minutes.

b- Diaphragmatic breathing exercises:

Position of the patient: Each patient was asked to lie in crock lying position and deviated her head to the other side.

Position of the therapist: Stride standing beside the mother and her hands was putting above the patients abdomen.

Command: Each patient was asked to take deep breathing from her nose push the physiotherapist hands upward. Then expire the air from her mouth and relax. This procedure was repeated 3 times then take a rest for 3 minutes and repeat the same exercise again in the same manner for 10 minutes.

Control group (Group B):

This group was consisted of 20 patients. Each patient in this group was asked to perform deep breathing exercises for 20 minutes, 3 times/week till the end of pregnancy and take her medical treatment (antihypertensive drugs) and follow with her doctor continuously till the date of delivery.

Deep breathing exercises (lateral costal breathing and diaphragmatic breathing) were performed in the same manner as in group (A).

Results

Comparison between the two groups (A & B) regarding to SBP:

Table (2) and Figs. (1,2) illustrate mean ± SD for SBP before and after treatment for both groups (A & B).

Variables	Group A		Group B	
	Before treatment	After treatment	Before treatment	After treatment
Mean ± SD	152.55±4.96	123.60±3.70	150.90±5.43	143.65±5.24
MD	28.95		7.25	
t# value	25.895		9.365	
p-value	0.001		0.001	
- % of in SBP	18.98%		4.80%	
Significance	Highly significant		Highly significant	

MD = Mean difference.

By comparing the two groups (A & B) after treatment regarding to SBP, it was found that, both groups showed a decrease in SBP after treatment, group (A) achieved 18.98% while group (B) achieved 4.8% but the percentage of decrease in SBP was more pronounced and more noticeable in group (A) when compared with group (B), this means that TENS on acupuncture points and diaphragmatic breathing exercises had a beneficial effect in lowering blood pressure in women with preeclampsia.

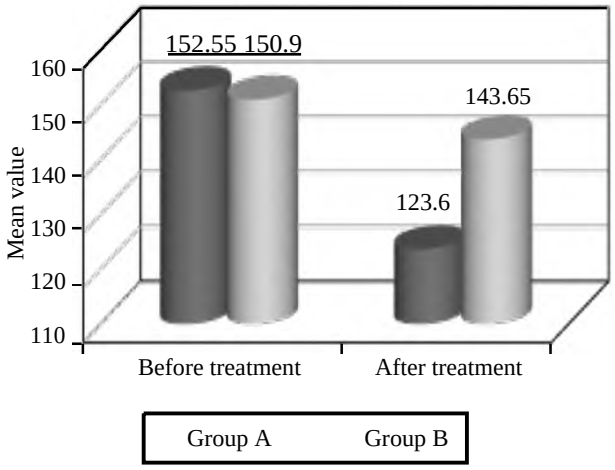

Fig. (1): Illustrates mean values of SBP measured before and after treatment in the two studied groups (A & B).

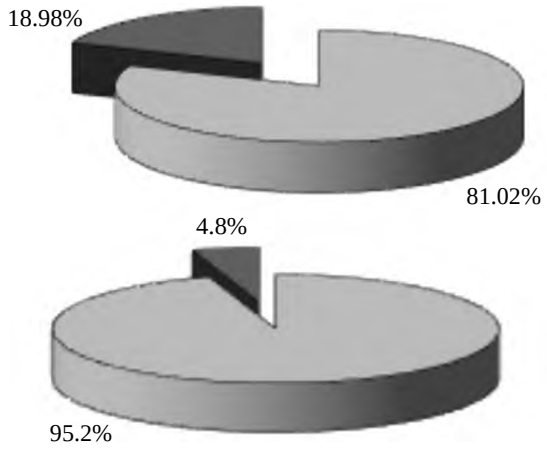

Fig. (2): Illustrates percentage of decrease in SBP after treatment in both groups (A&B).

Comparison between the two groups (A & B) regarding to DBP:

Table (3) and Figs. (3,4) illustrate mean ± SD for DBP before and after treatment for both groups (A & B).

Variables	Group A		Group B	
	Before treatment	After treatment	Before treatment	After treatment
Mean ± SD	94.45±2.44	79.05±1.64	95.40±2.72	91.35±2.25
MD	15.40		4.05	
t# value	23.674		9.796	
p-value	0.001		0.001	
- % of in DBP	16.30%		4.25%	
Significance	Highly significant		Highly significant	

MD = Mean difference.

By comparing the two groups (A & B) after treatment regarding to DBP, it was found that, both groups showed a decrease in DBP after treatment, group (A) achieved 16.30% while group (B) achieved 4.25% but the percentage of decrease in DBP was more pronounced and more noticeable in group (A) when compared with group (B), this means thatTENS on acupuncture points and diaphragmatic breathing exercise had a beneficial effect in lowering blood pressure in women with preeclampsia.

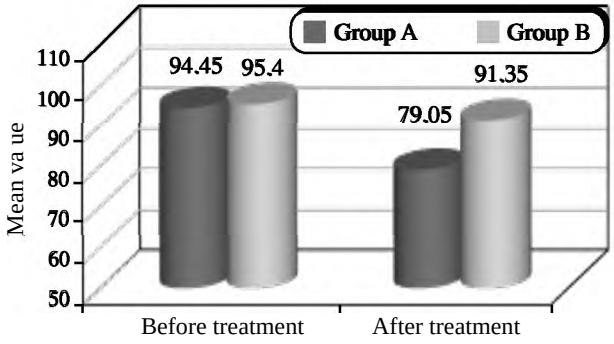

Fig. (3): Illustrates mean values of DBP measured before and after treatment in the two studied groups (A & B).

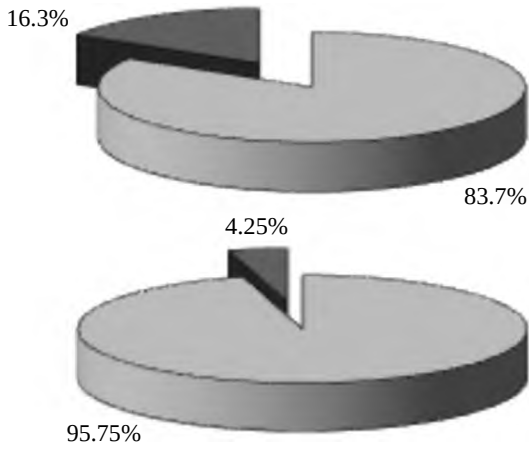

Fig. (4): Illustrates percentage of decrease in DBP after treatment in both groups (A & B).

Discussion

Mardiyanti & Anggasaril *[19]* reported that "trancautenous electrical nerve stimulation is a low cost non invasive intervention that has shown to reduce blood pressure in experimental and human studies including healthy and hypertensive individuals. He added that "Using tens device on acupionts (LI4), (LI11), (ST36) and (LR3) is a combination with antihypertensive drugs and deep breathing exercises on pregnant women with preeclamcia is the primary option to decrease blood pressure and improve quality of life of the mother.

The recent experimental studies that have made by Aalami & Modarres Gharavi 2024 approved that "deep breathing exercises have a significant effect on decreasing systolic and diastolic blood pressure in preclampsia "Several researches reported that "deep breathing exercises have a significant positive effect on hypertension in preeclampsia *[20]*.

Deep breathing exercises have a beneficial effect in decreasing systolic and diastolic blood pressure in women with pre eclampsia. Deep breathing exercises also cause a significant decrease in the heart rate. Added that "even a small decrease of 5 mmhg BP in hypertensive patients can lead to an approximately 25/decrease in cardiovascular complications" *[21]*.

Danielli et al., *[22]* emphasized that "breathing exercises are complementary and alternative medicine (CAM) which are being used by approximately 33.2/ of the women with preeclampsia. In addition to medication (anti hypertensive drugs). Deep breathing exercises are one of the non pharmacological methods which are recommended to control blood pressure. Danielli added that" deep breathing exercises have beneficial effect in reducing blood pressure among pregnant women with preeclampsia. Deep breathing exercises or yoga are different form of alternative therapy that is now being used to control hypertension".

Adam research revealed that acupressure stimulation could stimulate mast cells to release histamine as a mediator of the vasodilatation of blood vessels resulting in an increase of blood circulation that makes the body more relaxed and ultimately can lower blood pressure [23].

Acupressure is used to provide stimulus or stimulation at points of meridians of body by using finger that aims to (qi) body. The point intervent is the point of lr2 and point of lr3 the stimulus at those points will stimulate the sensory nerve cells around the acupressure points then forward the spinal cord manifestation and pituitary complex of the hypothalamus which all three are activated for releasing endorphin hormone that can provide sense of calm and comfort [24].

The relaxation conditions will affect the changes in blood pressure of elderly which stated that acupressure is effective for calm the mood reduce fatigue and lower blood pressure [25].

Conclusion:

Transcutaneous electrical nerve stimulation on accupoints (TEAS) with breathing exercisesis more effective in decreasing blood preesure in women with preeclamcia than medication and anti hypertensive drugs.

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تأثير التنبيه الكهربائى للعصب عبر الجلد ونقاط الوخز بالأبر وتمرينات التنفس البطنية على ضغط الدم فى السيدات المصابات بتسمم حمل

تهدف هذه الدراسة الى مقارنة تاثير التنبيه الكهربائى للعصب عبر الجلد ونقاط الوخز بالأبر بالاضافه الى تمارين التنفس العميق مع العلاج الدوائى على خفض ضغط الدم فى السيدات المصابين بتسمم الحمل.

أجريت هذه الدراسة على أربعين امرأة حامل فى الثلث الثالث والاخير من الحمل، يعانين من تسمم الحمل الخفيف. تراوح ضغط الدم الانبساطى لديهم بين (١٤٠–١٥٩) ملم زئبق وضغط الدم الانبساطى تراوح بين (٩٠–٩٩) ملم زئبق. تم اختيارهم عشوائياً من العيادة الخارجية لأمراض النساء والتوليد بمستشفى الزقازيق العام. وتراوحت أعمارهم بين (٢٥–٣٥) سنة، ولم يتجاوز مؤشر كتلة الجسم لديهم ٣٠ كغ/م٢، وتراوح عدد الولادات بين (٠–٣) أطفال. وتم توزيعهم عشوائياً الى مجموعتين متساويتين:

المجموعة الاولى: وتتكون هذه المجموعة من ٢٠ مريضا. تلقى كل مريض فى هذه المجموعة تحفيزًا عصبيًا كهربائيًا على نقاط الوخز الثنائية (LI4) و(LI11) و(ST36) و(LR3) التى تم تقديمها فى الأطراف العلوية والسفلية لمدة ٣٠ دقيقة .٣ مرات فى الأسبوع حتى نهاية الحمل. كما طُلب من كل مريضة أداء تمارين التنفس العميق لمدة ٢٠ دقيقة، ٣ مرات فى الأسبوع حتى نهاية الحمل. بالإضافة إلى ذلك، طلب من كل مريضة تناول علاجها الطبى والمتابعة مع طبيبها بشكل مستمر حتى موعد الولادة

المجموعة الثانية: تتكون هذه المجموعة من ٢٠ مريضاً. طُلب من كل مريضة في هذه المجموعة إجراء تمارين التنفس العميق لمدة ٢٠ دقيقة، ٣ مرات / أسبوع حتى نهاية الحمل وتناول العلاج الطبى والمتابعة مع طبيبها بشكل مستمر حتى موعد الولادة.

نتائج البحث: وبمقارنة المجموعتين (أ & ب) قبل وبعد العلاج فيما يتعلق بضغط الدم الانقباضى وضغط الدم الانبساطى، وجد أن كلا المجموعتين أظهرتا انخفاضاً فى ضغط الدم الانقباضى بعد العلاج، حيث حققت المجموعة (أ) ١٨,٩٨٪ بينما حققت المجموعة (ب) ٤,٨٪. وضغط الدم الانبساطى أظهرت انخفاضاً بعد العلاج، حققت المجموعة (أ) ١٦,٣٠٪ بينما حققت المجموعة (ب) ٤,٢٥٪ بعد العلاج. لكن نسبة الانخفاض فى ضغط الدم الانقباضى وضغط الدم الانقباضى كانت أكثر وضوحاً وأكثر وضوحاً فى المجموعة (أ) بالمقارنة مع المجموعة (ب).

الاستنتاج: نستخلص من هذه الدراسه ان تحفيز العصب الكهربائى عبر الجلد فى نقاط الوخز مع تمارين التنفس أكثر فعالية فى خفض ضغط الدم لدى النساء المصابات بتسمم الحمل من الأدوية المضادة لارتفاع ضغط الدم.