Original Article

The effects of progressive muscular relaxation and breathing control technique on blood pressure during pregnancy

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Abstract

Background: Hypertensive disorders in pregnancy are the main cause of maternal and fetal mortality; however, they have no definite effective treatment. The researchers aimed to study the effects of progressive muscular relaxation and breathing control technique on blood pressure (BP) during pregnancy.

Materials and Methods: This three-group clinical trial was conducted in Mashhad health centers and governmental hospitals. Sixty pregnant (after 20 weeks of gestational age) women with systolic BP ≥ 135 mmHg or diastolic BP ≥ 85 mmHg were assigned to three groups. Progressive muscular relaxation and breathing control exercises were administered to the two experimental groups once a week in person and in the rest of the days by instructions given on a CD for 4 weeks. BP was checked before and after the interventions. BP was measured before and after 15 min subjects' waiting without any especial intervention in the control group.

Results: After 4 weeks of intervention, the systolic (by a mean of 131.3 to 117.2, $P = 0.001$ and by a mean of 131.05 to 120.5, $P = 0.004$, respectively) and diastolic (by a mean of 79.2 to 72.3, $P = 0.001$ and by a mean of 80.1 to 76.5, $P = 0.047$, respectively) BPs were significantly decreased in progressive muscular relaxation and breathing control groups, but they were not statistically significant in the control group.

Conclusions: The interventions were effective on decreasing systolic and diastolic BP to normal range after 4 weeks in both the groups. The effects of both the interventions were more obvious on systolic BP compared to diastolic BP.

Key words: Blood pressure, breathing exercises, hypertensive disorders, muscle relaxation, pregnancy complications, pregnancy-induced hypertension

Introduction

Although pregnancy is one of the most pleasant situations in a woman's life, sometimes it is accompanied with diseases and problems such as increasing blood pressure (BP).[1,2] Pregnancy-induced hypertension has been defined as systolic BP of 140 mmHg and more or diastolic BP of 90 mmHg and more.[1,3] BP increases after the first half of pregnancy in gestational hypertension and preeclampsia, but is differentiated from preeclampsia by the absence of proteinuria.[4]

These disorders are the main cause of morbidity and mortality of fetus and mother across the world.[1,4,5] Pregnancy hypertension is the most common type of these disorders whose incidence is 6–7% in primiparous and 2–4% in multiparous women.[6] Gestational hypertension brings about several maternal and fetal complications such

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as increased fetal and neonatal mortality,[4,7,8] preterm labor,[3,6] low weight for gestational age,[3,6,9,10] intrauterine growth restriction,[11] abruption of placenta,[6,12] increased cesarean section delivery, heart and renal failure, and maternal death.[13]

First pregnancy,[6,14,15] aging,[10,16] high Body Mass Index before pregnancy,[6,14,16-19] multiple pregnancies,[6,14,16] race,[10,19,20] diabetes,[6,16,21] history of hypertension,[6,16] physical activity at the beginning of the pregnancy,[20] and poor socio-economic status[21] are considered as the main risk factors and predisposing factors.

Although they are problematic, there is no definite effective treatment for these disorders.[2,16] In most cases, delivery is recommended because of uncertainty of disorders.[16] So far, no evidence has been found for improving gestational or fetal consequences by complete or relative bed rest.[6,22,23] Changing diet has been also known to be ineffective in maternal–fetal improvement.[23] One of the most common methods is medical treatment. It is still questionable as the protective effect of antihypertensive drugs for gestational hypertension and chronic hypertension in comparison with preeclampsia has not been confirmed.[23]

However, the main question is about the etiology of an increase in BP in pregnancy.[3,6] Some hypotheses have been recently suggested for the role of stress in preeclampsia and hypertensive disorders during pregnancy.[24,25] The effect of stress in producing essential hypertension has been known clearly;[26] however, it has not been confirmed in pregnancy, and the results of the studies are controversial.[19,27-29]

Homeostatic imbalance may lead to a huge number of stress-induced diseases by overstimulation of target organ. Therefore, self-regulatory treatments are useful treatments for stress-induced disorders.[13] Relaxation techniques are used as an effective treatment for these kinds of disorders. The response to relaxation brings about homeostatic balance. Muscular tension decreases during relaxation, and peace of mind is achieved.[30]

Nowadays, different methods of relaxation have been used. The most common ones are diaphragmatic breathing, meditation, imagery techniques, music therapy, massage therapy, progressive relaxation, hypnotism, autogenic training, and biofeedback. They are different in terms of the way of administration, and each one has special elements and differs highly from others.[13] They are attractive economically as they are cheap.[31]

A bulk of research[32-34] showed the effect of progressive muscle relaxation on essential hypertension; however, meta-analyses have demonstrated its low to average effect.[35-37] But the effect of breathing control technique on chronic hypertension is more clear, and a decrease in BP has been observed in most cases by it.[38,39] These findings are true for non-gestational hypertension, and no evidence has been found for pregnancy-induced hypertension.[40] A study conducted in Helsinki (2006) reported that a significant decrease was observed in systolic BP and heart rate by progressive muscular relaxation in asthmatic pregnant women.[41] An outdated study in London (1984) showed that the systolic BP measured during progressive muscular relaxation was lower than in the control group (the number of hospitalized women in the control group was significantly higher). However, muscular relaxation could not decrease diastolic BP significantly.[42] According to the findings of this study, relaxation has a limited effect on decreasing gestational hypertension.[40] In some studies, the effects of muscular relaxation during pregnancy[42] and breathing control technique on diastolic BP in non-pregnancy conditions were not found to be significant.

No study has investigated the effect of breathing techniques on gestational hypertension.

Researchers aimed to investigate and compare the effect of muscular relaxation and breathing control technique on decreasing BP during pregnancy with regard to the ambiguous influences of different relaxation methods. Furthermore, there are some other elements such as lack of enough studies on diastolic pressure, impact and expenses of antihypertensive drugs, lack of similar studies, and ease of performing these techniques that should not be neglected.

Materials and Methods

This is a three-group before-after clinical trial conducted in Mashhad Qaem, Imam Reza, and Omm-ol-banin hospitals and two gynecologists' offices during 2009–2010. Based on the data received monthly from health centers no. 1, no. 2, and no. 3, six sub-centers with higher numbers of hypertensive pregnant women were selected. Informed consent was obtained from all the participants. Inclusion criteria were systolic BP ≥135 mmHg or diastolic BP ≥85 mmHg, absence of severe preeclampsia [diastolic BP ≥110 mmHg, proteinuria ++ and more, headache, visual problems, upper abdominal pain, oliguria, an increase in serum creatinine and liver enzymes, thrombocytopenia, intrauterine growth restriction (IUGR), pulmonary edema] or eclampsia, absence of chronic hypertension or hypertension before 20 weeks, gestational age of 20–36 weeks, single pregnancy, no contraction or bleeding, absence of underlying diseases and mental disorders, absence of polyhydramnios, hydatidiform

mole, and placenta previa, not being addicted to drugs, alcohol, mood-altering medicine, and cigarette, not using similar relaxation methods and breathing techniques during pregnancy, reading and writing literacy, and having a contact number. Exclusion criteria were using antihypertensive drugs (for experimental groups), complete bed rest, bleeding, contraction or leakage during the study, deterioration of preeclampsia to a severe form, hospitalization, starting medical treatments for experimental groups, subjects' decision to leave the study, being absent in one session of personal instructions in the experimental groups, not doing exercises of more than three sessions of relaxation and breathing control at home, occurrence of delivery during the 4-week intervention, and presence of symptoms such as confusion, fatigue, feeling of suffocation, pain, and blurred vision during doing exercises.

Subjects were selected using non-probable convenience sampling. They were randomly assigned to three groups. The order of the three groups was decided by drawing of lots. The first 10 were assigned to relaxation, the second 10 to breathing technique, and the third 10 subjects were assigned to the control group. It was repeated during the study. After a pilot study was conducted on 10 subjects of each group, the sample size was calculated by comparing the means formula (no. = 18 subjects in each group). Study continued until 20 subjects entered the study for more confidence and consideration of 10% more subjects, selected in sampling. In the relaxation group, two patients were excluded because of delivery, two because of their decision to leave the study, and one for starting medical treatments. In the breathing control group, four cases were excluded because of their decision to leave the study, two for delivery, and another one as she wanted to go on a vacation. In the control group, one subject was excluded for her decision to leave the study and another one as she wanted to go on a vacation.

Data collection tools were an interview form containing demographic and midwifery data, and a checklist for doing exercises in the class and at home.

In this study, two methods of progressive muscular relaxation and breathing control were compared. The researcher was trained by a psychologist to administer the techniques. It took 4 weeks for the subjects to do exercises in four classes that were held at Omm-ol-banin hospital. For the rest of the week, they followed researcher's oral instructions that had been recorded on a CD, at home. Continuation of doing exercises was followed by the phone calls. The symptoms of severe preeclampsia were checked both by phone calls and at the beginning of each personal class. In the personal classes, necessary explanations were given about doing exercises after the primary interventions and control of BP. The subjects were asked to empty their bladder and be in a convenient position (sitting or lying).

Progressive muscular relaxation was done using Jacobson method[13] by contracting and relaxing selected groups of muscles until total relaxation was achieved. Subjects were asked to contract and then relax their muscles including hands, different parts of face, shoulders, and other parts by the researcher's order. Each exercise session took around 20 min.

Breathing control technique included deep diaphragmatic breathing and decreasing the respiration rate to 6–10/min. Subjects were guided to do 20 deep diaphragmatic respirations, which took around 5 min.

No intervention was done in the control group. They received routine care given in the clinic or health center and used medications, if needed. In this group, the researcher checked the BP weekly for 4 weeks.

BP in all three groups was measured from the right hand at the level of the heart after 5 min, resting in a chair in sitting position. The first Korotkoff sound was regarded as the systolic BP and the last was considered as the diastolic BP.

Data were analyzed by one-way analysis of variance (ANOVA), Kruskal–Wallis, paired *t*-test, and Chi-square test through SPSS 11.5.

Ethical consideration

This survey was done as a part of a Master's degree thesis, registered in the site of clinical trial with the ID number NCT01664988. Mashhad University ethics committee approval has been obtained for this study.

Results

Three groups were matched and showed no significant difference in terms of jobs, socioeconomic class, body mass index, age, gestational age at their entry into the study, intended or unintended pregnancy, the number of deliveries, subjects' history of hypertensive disorders in their previous pregnancies or in their sister's or mother's, and taking calcium, iron, and multivitamin supplements.

Also, no significant difference was found between groups in systolic BP ($P = 0.091$) and diastolic BP ($P = 0.400$) at the beginning of the study. However, after 4 weeks of intervention, they were significant differences in progressive muscular relaxation ($P = 0.000$ for systolic BP, $P = 0.001$ for diastolic BP) and breathing control ($P = 0.004$ for

systolic BP, $P = 0.047$ for diastolic BP) groups, but they were no statistically significant differences in the control group [Table 1].

In weekly comparison of BP before and after the intervention, the results were deliberating. In the progressive muscular relaxation group, the difference was significant for systolic BP from the first week and continued up to the end (week 4) [Table 2]. Although the decrease in diastolic BP was significant after week 4 [Table 1], in weekly comparison, it was significant just in the second week ($P = 0.000$) [Table 2]. The decrease in diastolic BP was significant before intervention at the first week, compared to after intervention in the 2nd, 3rd, and 4th weeks [Table 3].

Table 1: Means of pre- and post-interventional BPs in the three groups

Group	Blood pressure	Pre-intervention		Post-intervention		*P* (*t*-paired test)
		Mean	SD	Mean	SD	
Muscular relaxation	Systole	131.3	8.4	117.3	9.2	0.000
	Diastole	79.2	11.2	72.3	10.5	0.001
Breathing control	Systole	131.1	10.4	120.5	14.2	0.004
	Diastole	80.1	12.6	76.5	13.1	0.047
Control	Systole	137.8	12.9	136.3	14.8	0.630
	Diastole	85.5	22.7	85.1	11.6	0.893

SD: Standard deviation, BP: Blood pressure

Table 2: Means of weekly pre- and post-interventional BPs in muscular relaxation group

Weeks	Blood pressure	Pre-intervention		Post-intervention		*P* (*t*-paired test)
		Mean	SD	Mean	SD	
First	Systole	131.4	8.4	124.9	8.0	0.015
	diastole	79.3	11.3	76.7	9.1	0.124
Second	Systole	128.3	12.5	117.7	11.8	0.000
	Diastole	79.9	7.3	73.9	7.0	0.000
Third	Systole	125.7	11.9	118.1	11.5	0.000
	Diastole	76.3	8.1	73.9	8.7	0.143
Fourth	Systole	123.3	10.6	117.4	9.3	0.000
	Diastole	74.3	10.7	72.3	10.5	0.100

SD: Standard deviation, BP: Blood pressure

In the breathing control group, the decrease in systolic BP was significant from the first week [Table 4]; however, the decrease in diastolic pressure was significant after intervention in the 3rd and 4th weeks [Table 4]. Comparison of the diastolic BP before intervention at the first week and after intervention (at 1st, 2nd, 3rd, and 4th weeks) showed a significant difference just in the 4th week [Table 3].

Discussion

This study aimed to compare the effects of progressive muscular relaxation and breathing control technique on BP during pregnancy. According to the results, systolic BP decreased not only after 4 weeks but also after the weekly intervention in the relaxation and breathing control groups, while it showed no significant decrease in the control group.

Both groups showed a significant decrease in diastolic BP after 4 weeks. In the progressive muscular relaxation group, it was significant in the 2nd session and in the breathing control group, it was significant in the 3rd and the 4th sessions, while it was not significant in the control group. So, it could be concluded that both techniques were effective on decreasing diastolic and systolic BP after 4 weeks.

Nickel *et al*., in their study conducted in Helsinki, aimed to study the effect of progressive muscular relaxation on the BP change, pulmonary parameters, heart rate, anger, and quality of life in asthmatic pregnant women and reported similar results. In their study, a significant decrease was observed in systolic BP and no result was reported for diastolic BP.[41]

Little *et al*. in London aimed to detect the effects of relaxation with or without biofeedback in decreasing BP and preventing hospitalization and compared their effects on gestational consequences.[42] They reported a decrease in systolic BP after 6 weeks, which is similar to the present study. Meanwhile, no difference was observed in diastolic BP, which is not in line with the present study.

Table 3: Means of the first pre-interventional BP with weekly post-interventional BPs in the two interventional groups

Group	Pre-interventional first week blood pressure	*P*			
		1st week post-interventional	2nd week post-interventional	3rd week post-interventional	4th week post-interventional
Muscular relaxation	Systole	0.002	0.000	0.000	0.000
	Diastole	0.124	0.019	0.003	0.001
Breathing control	Systole	0.002	0.003	0.017	0.004
	Diastole	0.123	0.817	0.403	0.047

BP: Blood pressure

Table 4: Means of weekly pre-interventional BPs with post-interventional BPs in the breathing control technique group

Weeks	Blood pressure	Pre-intervention		Post-intervention		*P* (*t*-paired test)
		Mean	SD	Mean	Deviation	
First	Systole	131.1	9.9	124.7	10.2	0.002
	Diastole	79.6	12.0	77.9	12.1	0.123
Second	Systole	130.3	12.0	123.5	10.9	0.000
	Diastole	81.4	11.2	79.3	10.2	0.080
Third	Systole	128.7	11.8	123.8	11.2	0.007
	Diastole	80.5	13.7	78.4	12.4	0.000
Fourth	Systole	125.4	14.6	120.5	14.3	0.003
	Diastole	81.2	14.6	76.5	13.2	0.009

SD: Standard deviation, BP: Blood pressure

Kaushik *et al*. reported results similar to the present study. They studied the effects of mental relaxation and slow breathing on essential hypertension.[43] They concluded that both methods decreased systolic BP effectively; however, mental relaxation could not decrease diastolic BP. They found that slow breathing was more effective on decreasing BP, compared to mental relaxation.

Joseph *et al.* in Italy[39] showed that slow breathing could decrease systolic and diastolic BPs more than spontaneous breathing.

Findings of the present study are not consistent with the study of Urech *et al*. They compared immediate effects of two techniques of progressive muscular relaxation and mental imaging on mental secretive and cardiac functions of pregnant women in Switzerland. No significant change was observed in the intervention and control groups.[44] Although they utilized a rapid method and one session of muscular relaxation, in our study, significant decreases were observed in systolic BP at the first session and in diastolic BP in some sessions.

It could also be concluded that just one session of muscular relaxation or breathing control is enough for decreasing systolic BP, but for decreasing diastolic BP, at least 2 weeks of muscular relaxation and 4 weeks of breathing control are necessary. In general, the effects of both techniques were more obvious on systolic BP compared to diastolic BP.

In both the two experimental groups, no subject needed a medical treatment; however, in the control group with no intervention, six patients underwent medical treatments due to high BP. Based on statistical analyses, a significant difference was found between the two intervention groups and the control group in terms of decreasing BP. It could be mentioned that the decrease in BP in the control group could be partly attributed to the medications. If the six patients taking medications in the control group are excluded, the difference between groups would become much more and the *P* value would decrease. Consequently, the sample size would decrease. Therefore, it was not statistically possible.

Conclusion

Our obtained results show that muscle relaxation and breathing control technique could be effective in decreasing the BP in hypertensive disorders during pregnancy.

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Conflicts of interest

There are no conflicts of interest.

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