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RESEARCH ARTICLE

Effects of Deep Breath on Blood Pressure in Normo-Prehypertension Subjects

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Abstract

Background: Blood pressure (BP) levels variety throughout the day, both by internal stimuli and the influence of external factors. The BP which measured at the clinic are higher than self measurement at home. Deep breathing (DB) is a technique which deep breaths <10x/minute,which can lower BP through activation of chemoreceptors and baroreceptors. The aim of this study is to know the effect of DB on systolic blood pressure (SBP) and diastolic blood pressure (DBP) in the normo-prehypertensive population.

Methodology: This study design was one-group pre-post test clinical trials. automatic blood pressure monitoring (Omron HEM-7320) was measured in 119 subjects, aged 25-50 years. Measurements without DB after the subject sat down for 5 minutes of rest followed by the 1st, 3rd and 5th minute measurements when the subject was resting, BP measurement DB after the subject sits rest 5 minutes then performed (breathing 8 cycle/min following the rhythm by

the application paced simulation breath on smarthphone android) continued measurement at 1 minute, 3rd and 5th after DB.

Results: 56 male and 63 female, where 66 subjects found normotensive and 53 subjects prehypertensive. The largest decrease in SBP after Deep Breath Test (DBT) at 1st minute (6.61+3.9 mmHg) followed by 3rd and 5th (5.56+4.7 and 3.38+5.3 mmHg), while DBP at 1st minute (3,33+4,34 mmHg) followed by 3rd and 5th (2,34+4,14 and 1,11+4,71 mmHg). The comparison between the reduction of SBP and DBP before DB and after DB was statistically significant at 1st and 3rd minute (0.9+3.1vs 6.6+3.9mmHg), (1.5+3.6vs5.6+4.8mmHg) and DBP in 1st and 3rd minute (0.8+4.3vs3.3+4.3mmHg), (1.3+4.9vs2.3 +4.1mmHg) (P<0.05). At 5th minutes, the change was statistically significant only in SBP (1.4+4.1vs3.4+5.4mmHg)(p=0.002),while the DBP was not statistically significant (1.4+5.0vs1.1+4.7mmHg) (p=0.699)

Conclusion: Deep Breathing descreased SBP and DBP significantly,especially in the first minute followed with third and fifth minutes.

Key Word: Deep Breath Test, Deep Breath, Deep Breath

1. Introduction

Hypertension is an important health problem because of its prevalence more increased and resulting to morbidity and mortality. BP level was associated with reno-cerebro-cardiovascular risk, where the higher BP the greater of its risk. It had been reported that every 20 mmHg SBP or 10 mmHg DBP increase in cardiovascular risk 2 fold.(1) Therefore, the accuracy of BP measurement is very important to diagnose hypertension and decide which treatment to obtain.

The American College of Cardiology (ACC) and the American Heart Association (AHA) set SBP ≥130 mmHg or DBP ≥80 mmHg as criteria for hypertension.(2), while The European Society of Hypertension (ESH) and European Society of Cardiology (ESC) define SBP ≥140 mmHg and / or DBP ≥90 mmHg as hypertension.(3)

The BP level varies throughout the day, both by internal stimuli and by the influence of external factors. Studies have shown that BP measured in the clinic is higher than that measured at home. One of the hypotheses that explained this phenomenon is psychological stress on the examination environment.(4)(5) If this difference confirmed by 24-hour ambulatory blood pressure monitoring (ABPM), this phenomenon is known as white coat syndrome (WCS). which consists of 1) white coat effect (WCE), 2) white coat hypertension (WCH), and 3) white coat normotension (WCN) or masked hypertension (MH).(4)(6)

Deep breathing is a technique to increase lung capacity and lung oxygenation. Deep breathing will trigger baroreceptors and chemoreceptors which will result to decrease sympathetic nerve activity and increase parasympathetic nerve activity.

2. 1Method

This study is a clinical trial using a one-group pre-post test design, from November until December 2020.

2.2. Research subject

Age 25 - 50 years, male and female not pregnant, subjects with SBP <140mmHg or DBP <90mmHg, no using anti-hypertensive drugs, no diabetes mellitus, no hyperthyroidism

2.3. Statistic analysis

Statistical tests: 1) Paired-t test for comparison of BP before and after DBT, 2) Independent t-test for comparison of BP according to Normo-Prehypertension, and time. The result is statistically significant if the p value <0.05

2.4. Research Ethical Clearence

It has been approved by the Biomedical Research Commission on Humans, Hasanuddin University Medical Faculty with the number 758 / UN4.6.4.5.31 / PP36 / 2020.

3. Results

3.1. Analysis of Subject Characteristics

From 119 non-hypertensive subjects, the age range was between 26-42 years with mean age was 31.9 + 3.1 years, male 47.1% with a normotensive subjects was 55.5% and prehypertension 44.5% (Table 1).

3.2. Analysis of blood pressure reduction without Deep Breath Test according to time

BP measurement without doing DB showed a decrease in BP, this reduction was statistically significant in SBP with the highest decrease in the third minute without DB and in DBP only at the third and fifth minutes with the highest decrease in the fifth minute without DB. After doing DB + 8x / minute, the SBP decreased. This reduction was statistically significant in SBP and DBP with the highest decrease in the first minute after DB. (Table 2)

3.3. Comparative Analysis of Blood Pressure reduction with and Without Deep Breath Test

Comparison of reduction in BP between without DBT and after DBT, the TDS was statistically significant at 1, 3 and 5 minutes and in TDD only at 1 and 3 minutes (Table 3)

3.4 Analysis of Changes in Proportion of Prehypertension and Normotension Based on Time After Deep Breath Test Compared to Baseline Blood Pressure

In this study, an analysis of changes in the proportion of prehypertension was also carried out after doing DB to normotension. (Table 4).

4. Discussion

The European Society of Cardiology (ESC) and the European Society of Hypertension (ESH) recommend a BP measurement time in the clinic of 3 minutes and the American Heart Association (AHA) recommends an ideal time of 5 minutes before starting BP measurement.(3)(10) Guillaume et al.(11) evaluated 199 subjects, at the end of the simulation showing that 50% of the subjects were stable at 5 mmHg SBP after 5 minute rest, 90% of the subjects with BP stability were at rest after 25 minutes. In this study, 119 subjects without DBT showed a decrease in BP both SBP and DBP at the first, third and fifth minutes, the decrease from the initial SBP was statistically significant at the first, third and fifth minutes for DBP (Table 2). So it takes a more efficient method of measuring BP time in the clinic.

Clinical is a place of interaction between doctors and patients, this environment has a great effect on some patients emotionally this will increase anxiety and blood pressure so that it becomes biased in diagnosing hypertension.(12) Slow and regular breathing of less than 10x / minute is known to affect reflex control of the cardiovascular system to lower blood pressure. When inhaling in many different reflex pathways (reflex pulmonary stretch receptors, arterial baroreceptor reflex and arterial reflex chemoreceptors) are stimulated simultaneously. Pulmonary inflation increases with a decreased respiratory rate, stimulating pulmonary stretch receptors, this functions as medullary stimulation in relation to blood pressure, which is generated by arterial baroreceptors. Stimulation of pulmonary stretching is delivered by afferent nerves, slow adaptation when pulmonary inflation causes cardiac acceleration and vasodilation in a number of regional vascular areas.(7) In this study the subjects performed DBT + 8x / minute (inspiration 4 seconds and expiration 4 seconds) showed a decrease in SBP and DBP. from the initial SBP and DBP, both the first, third and fifth minutes after DBT were significant with each value of p = 0.000 where the greatest decrease was obtained in the first minute after DBT from initial SBP and initial DBP 114.66 +11.4 and 75.61+ 7.78 to 108.05 +12.2 and 72.28 + 8.84 mmHg) or a decrease of 6.61 and 3.33 mmHg) see table 3.The same is shown by several previous studies by Hisao Mori et al. (13) on 18,633 Subjects showed a significant reduction in SBP and DBP and pulse after DBT was done in the normotension, controlled and uncontrolled hypertension groups. Kersti et al (14) on 13 subjects after doing DBT decreased SBP, DBP and Mean Blood Pressure were lower than before DBT respectively 9.1, 4.3 and 5.9 mmHg. Tess E et al(15) reported a decrease in SBP (3.2 and 0.8 mmHg) and DBP (1.3 and 0.4 mmHg) during deep breathing. Natalia Herkova et al(16), reported on the DBT model of breathing (slow and deep breathing with inspiration 4.5 seconds and 4.5 seconds of expiration) decreased breathing DBT (slow and deep breathing with inspiration 4.5 seconds and 4.5 seconds expiration) a significant decrease in SBP and DBP by 3.7 ± 5.7 / 3.7 ± 5.0 mmHg. The autonomic nervous system, through stimulation of arterial baroreceptors, pulmonary stretch receptors, and low pressure at baroreceptors, may play an important role in changes in blood pressure associated with DBT, although the exact mechanism is not yet known.(13)

We compared 119 subjects with BP measurements twice at different times where the first measurement was not carried out by DBT while the second measurement was carried out by DBT. The results showed that both without DBT and after DBT there was a decrease in SBP and DBP. The comparison of the two on SBP was statistically significant both at the first, third and fifth minutes. (Table 3) In line with previous studies; D Zheng et al(17) on 111 subjects found that there was a significant difference in the mean reduction in SBP and DBP (4.4 and 4.8mmHg) after DBT compared to resting measurements. Alberto R et al(18) on 24 healthy male subjects, the comparison of BP between spontaneous breathing and slow and regular breathing 2x / minute showed a significant decrease in BP where controlled breathing 15x / minute (identical to spontaneous breathing) was not found to change blood pressure. Chan et al(6) on 178 subjects showed that DBT could be used to detect WCE in subjects with SBP before DB> 165 mmHg and did not use beta-blocker drugs with a specificity of 90.9% if the decrease in SBP after DBT was> 30mmHg. So for time efficiency and accuracy of BP examination at the clinic, it is recommended to perform the DBT maneuver for 1 minute as part of parasympathetic reactivation followed by BP examination less than five minutes after DBT.

In this study see the change amount of prehypertension become normotensive subjects after DBT. (Table 4) This shows the effect of DBT as much as + 8x / minute (4 seconds of inspiration and 4 seconds of inspiration) can reduce BP in the prehypertensive population. This is in line with various previous studies by Pratik et al. (19) on 30 prehypertensive subjects from a total of 60 subjects with the DBT technique 6x / minute (5 seconds of inspiration and 5 seconds of expiration) which can reduce BP in prehypertensive subjects when measuring BP both on SBP and DBP was statistically significant. Iryna et al (20) on 35 prehypertensive subjects and 39 normotensive subjects DBT 6x / minute (with a ratio of inspiration and expiration 1: 1) can reduce BP both in SBP and DBP in prehypertensive subjects. However, these two studies did not look how many subjects changed from prehypertension to normotension. The reduction in BP after DBT was carried out in our study, we assume that most of the prehypertensive subjects had a tendency towards WCE. This is because several studies reported an association between a decrease in BP after DB when measuring BP in the clinic can predict the occurrence of WCE, one of which was reported by Talenberg et al.(9) who studied 101 hypertensive subjects who had stopped anti-hypertensive drugs 2-3 weeks for DBT's accuracy in identifying WCE. DBT response was assessed with normalized SBP <140 mmHg or DBP <90 mmHg. Blood pressure before and after DBT was 152 ± 17/99 ± 11 and 140 ± 18/91 ± 11 mmHg.

Summary

119 subjects were studied where the female gender was 52.9% and prehypertension 44.5%. The mean reduction in SBP without DBT was significant at minute 1 (0.9 + 3.1 mmHg), at minute 3 (1.5 + 3.6 mmHg), at minute 5 (1.4 + 4.1 mmHg) and after DBT significant at minute 1 (6.61 + 3.9 mmHg), at minute 3 (5.6 + 4.8 mmHg) and minute 5 (3.4 + 5.4 mmHg) with each value p <0.05. The mean reduction in DBP without DBT was significant at minute 3 (1.3 + 4.9 mmHg) and minute 5 (1.4 + 5.0 mmHg), not significant at minute 1 (0.8 + 4.3 mmHg

p = 0.060) and after DBT was significant at minute 1 (3.33 + 4.34 mmHg), minute 3 (2.34 + 4.14 mmHg) and minute 5 (1.11 + 4.71 mmHg) each p=0,000. The comparison of the decrease in SBP before and after DBT was significant at minute 1 (0.9 + 3.1 vs 6.6 + 3.9 mmHg p = <0.001), minute 3 (1.5 + 3.6 vs 5.6+ 4.8 mmHg p = <0.001) and 5 minutes (1.4 + 4.1 vs 3.4 + 5.4 mmHg p = 0.002) and the comparison of the decrease in DBP before and after DBT was significant at minute 1 (0, 8 + 4,3 vs 3,3 + 4,3 mmHg p = <0,001), minute 3 (1,3 + 4,9 vs 2,3 + 4,1 mmHg p = 0,034), not significant at minute 5 (1.4 + 5.0 vs 1.1 + 4.7 mmHg p = 0.699). After doing DBT prehypertensive subjects from 53 subjects to 34 prehypertensive subjects in the first minute, to 44 prehypertensive subjects at the third minute and to 47 prehypertensive subjects at the fifth minute.

Conclusion

Deep Breathing descreased SBP and DBP significantly, especially in the first minute followed with third and fifth minutes.

References

Table 1.Distribution of Demographic Research Subjects Characteristics (n = 119)

Variabel	n	%
Gender		
Male	56	47,1
Female	63	52,9
Blood pressure		
Normotensiion	66	55,5
Prehypertensio n	53	44,5

Table 2. Analysis of Decrease in Systolic, Diastolic Blood Pressure Without and After Deep Breath Test Based on Time (n = 119)

Variabel	Without DBT Mean±SD	P	After DBT Mean±SD	P
SBP, mmHg				
Baseline	115,39±11,5	-	114,66±11,4	-
Minute 1	114,49 ±11,9	**0.002**	108,05±12,2	**0.000**
Minute 3	113,92 ±12,1	**0.000**	109,10±12,1	**0.000**
Minute 5	114,03±11,7	**0.000**	111,29±12,0	**0.000**
DBP, mmHg				
Baseline	76,30±8,0	-	75,61±7,78	-
Minute 1	75,55±8,6	0.060	72,28±8,8	**0.000**
Minute 3	75,03±8,8	**0.005**	73,26±8,45	**0.000**

Minute 5	74,9 ±8,5	**0.004**	74,5 ±7,8,8	**0.000**

Paired-t test; DBT = Deep Breath Test; SD = Standard Deviation;
SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure

Table 3. Comparative analysis of the decrease in mean systolic, diastolic blood pressure without and after the Deep Breath Test based on time (n = 119)

Variabel	Mean±SD		P
	Without DBT	After DBT	
SBP, mm Hg			
Minute 1	0,9±3,1	6,61±3,9	**<0,001**
Minute 3	1,5±3,6	5,56±4,7	**<0,001**
Minute 5	1,4±4,1	3,38±5,3	**0,002**
DBP, mmHg			
Minute 1	0,8±4,3	3,33±4,34	**<0,001**
Minute	1,3±4,9	2,34±4,14	**0,034**
Minute 5	1,4±5,0	1,11±4,71	0,699

Paired-t test; DBT = Deep Breath Test; SD = Standard Deviation;
SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure

Table 5. Changes in the Number of Prehypertensive Subjects after DBT compared to BP0

Variable	Blood pressure		%	P*
	Prehypertension	Normotension		
BaseLine	53(44,5%)	66(55,5%)	100	**(Base Line)**
BP1 after DB	34(28,6%)	85(71,4%)	100	**0.000**
BP3 after DB	44(37,0%)	75(63,0%)	100	**0,035**
BP5 after DB	47(39,5%)	72(60,5%)	100	0.210

*McNemar test