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Changes in Parameters of Arterial Stiffness with Posture in 41 Hypertensive Patients on Anti-Hypertensive Treatment

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1. Abstract

1.1. Objective: To determine changes in parameters of arterial stiffness with posture in 41 hypertensive patients on anti-hypertensive treatment

1.2. Method: Postural variations of parameters of arterial stiffness are measured in hypertensive patients on anti-hypertensive medication (n=41). Operator index, central aortic systolic pressure (ASP), central aortic pulse pressure (APP), Augmentation Index (AI) and brachial systolic pressure (SP) and brachial diastolic pressure (DP) were measured in supine and sitting positions. Parameters of arterial stiffness were obtained through Sphygmo-Cor device between 8am to 10am initially on supine position. After three minutes, values in sitting position were obtained. Ethics approval was taken. Demographics such as age, race, gender, height and BMI were noted. Differences between BP characteristics in supine and sitting were compared using non-parametric paired test of Wilcoxon Signed-rank test.

1.3. Results: A statistically significant decrease in median APP (38(35-54) vs 38(31-48), p=0.0058) and a significant increase in median DP (74(69-83) vs 76(69-87), p=0.023) was observed in hypertensive subjects on medications when moved from supine into sitting position.

1.4. Conclusions: Parameters of arterial stiffness vary with postural changes in hypertensive subjects on anti-hypertensive medications. The parameters of arterial stiffness reduce in sitting position compared to supine position. The significance of these variations is not well known but it may indicate reduction in cardiovascular events when patient is in sitting positon and may be on activity or exertion.

2. Introduction

Arterial stiffness is directly related to increased cardiovascular events [1-7]. Increased arterial stiffness, is a measure of the elasticity of arteries, has been shown to increase the risk of myocardial infarction and stroke. European Society of Hypertension guidelines on the management of hypertension acknowledges that central pressures (measure of arterial stiffness) may be more predictive of cardiovascular events when compared to brachial pressures. This is due to different antihypertensive drugs potentially having different effects on peripheral pressures and central pressures [8]. Furthermore, increased arterial stiffness is a better predictor of disease progression as they more sensitive to cardiac changes as compared to peripheral pressures [9]. Effect of postural variation for parameters of arterial stiffness has not been well studied and was evaluated in this study.

3. Methods

In this study, postural variations and their effects on measures of arterial stiffness were analysed for hypertensive patients on anti-hypertensive medication. Operator index (OI), central pressures such as aortic systolic pressure (ASP), aortic pulse pressure (APP), Aortic Pulse Augmentation (APA), Augmentation Index (AI) and brachial blood pressures (BP) such as brachial systolic pressure (SP) and brachial diastolic pressure (DP) were measured in supine and sitting positions. Median values and interquartile range was calculated for all these parameters and compared between supine

and sitting positions. Subjects with hypertension had follow up with clinic physicians and were chosen based on their diagnosis of hypertension on ambulatory blood pressure monitoring or had two average brachial blood pressure readings above 140/90 mm Hg on at least two separate occasions in clinic.

The parameters of arterial stiffness were measured by using a Sphygmo-Cor device in the morning between 8am to 10am initially on supine position. After three minutes, values in sitting position were obtained. Subjects were advised to refrain from smoking, eating or drinking beverages three hours before the test and drinking alcohol 10 hours before the test. As a clinic protocol, young hypertensive, hypertensive patients with diabetic mellitus with chronic kidney disease, elderly patients with labile blood pressure and patients with aortic aneurysm and dissection were chosen to undergo the arterial stiffness study. Informed verbal consent was obtained from all participants and ethics approval was obtained before the start of the study. Summary measures on demographics such as age, race, gender, height, weight and BMI were noted. Differences between BP characteristics in supine and sitting were compared using paired T-test and Man Whitney u-test. A p-value of $p < 0.05$ was accepted as statistically significant. Bad or incomplete data, low operator index values (<80%) and data with incomplete patient information were excluded from the study.

4. Results

When postural variations parameters of arterial stiffness and brachial BP were studied in hypertensive subjects on antihypertensive medication, a statistically significant increase in APP (38(35-54) vs 38(31-48)=0.0058) and a significant decrease in DP (74(69-83) vs 76(69-87), p=0.023) was seen in the supine position as compared to in the sitting position (Table 1).

Table 1: Hypertensive subiects on antihypertensive medication

	Hyper tensive subjects on anti-hypertensive medication		
Number		41	
Mean age in years SD	45.3 (19.5)		
Mean BMI SD	29.2 (7.4)		
Parameters	Supine	Sitting	P-value
Median Aortic SP mm Hg (Interquafiile range)	119 (112-130)	119 (113-127)	0.74896
Median Aortic PP mm Hg (Interquaftile range)	38 (35-54)	38 (31-48)	0.00578
Median AP Aortic Augmentation (Interquafiile range)	6 (0-17)	4 (1-14)	o. 79486
Median Al Aortic Augmentation Index (Interquartile range)	14 (2-28)	9 (2-28)	0.83366
Median SP mm Hg (Interquartile range)	136 (128-144)	138 (131-144)	0.71138
Median DP mm Hg (Interquartile range)	74 (69-83)	76 (69-87)	0.0226

5. Discussion

In a recent study, a significant increase in APP and AI in supine position was discovered when compared to the values obtained from the sitting position. [10] The increase in APP in supine position was consistent with the results of this study in the groups with hypertensive subjects on medication and normotensive subjects. However, this variation was not seen in hypertensive subjects off medication. Moreover, no difference in AI was noted in any of the groups in this study. Another study by Nürnberger et al noted that there was a significant increase in the DP in sitting position as compared to in the supine position. [11] This was also consistent with our findings in hypertensive subjects on medication and normotensive subjects. The latter study also did not note any significant difference in the AI which is similar with our findings.

A previous prospective pilot study carried out at our centre on 21 patients by Ashish et al, reported that normotensive subjects had a significantly high supine APP and AI values compared with those in sitting postures [12]. While the effects of different anti-hypertensive medication on arterial stiffness have been explored, multiple studies agree that angiotensin-converting enzyme inhibitors, angiotensin receptor blockers and calcium channel blockers have beneficial effects on reducing arterial stiffness. [13-24] Mutiple studies have shown that arterial stiffness can vary with age, obesity and aerobic exercise. [25-27]

There are different studies showing changes in arterial stiffness with posture. These studies are mainly done in Caucasians and not in Asian population. The studies also show postural variations with parameters of arterial stiffness in diabetes mellitus and with fasting [28-31]. A study conducted by Stoner Lee et al. concluded that pressure taken in the supine position was more reliable than when seated. [30,33] As APP and AI values also tended to be significantly higher in the supine position, underdiagnoses could be prevent-

ed when more weight is given to the BP values taken in the supine posture during diagnosis. A study carried out by Bas van den Bogaard et al. highlighted that between supine and upright position, arterial wave reflection tended to be higher in the supine position. [34] Another study carried out by Alyssa Torjesen et al. concluded similar results of the study we carried out, adding that the negative relation between forward wave amplitude and change in mean arterial pressure on standing was accentuated in women.31 This could help guide future policy guidelines on BP measurements, allowing for more accurate BP readings to be obtained. Furthermore, a study carried out by Yusuke Kobayashi et al. concluded that higher arterial stiffness could be deduced from the size of BP drop when moving from the supine to sitting position. [32] This could help identify patients with Diabetes Mellitus who have a higher cardiovascular risk for early intervention treatment. There are some limitations to this study. Mainly, there was a high variance of the demographics in the sample population. The hypertensive groups consisted of more than 80% of Chinese population. Subjects from hypertensive group on medication had a high BMI (29) and average age (44.7+/-19.5). Several studies have highlighted that age, physical conditioning, obesity, ethnicity, obesity related diabetes, and body height are all strong determinants of augmentation index. [13,25-27] Hence, this demographical variation could have had an effect on the data. Despite the limitations, this study has several strengths too as it has novel data comparing BP characteristics on different positions and different patient groups were compared. Measurement of BP characteristics using SphygmoCor is a relatively safe and non-invasive procedure. Values with a operator index <80% were excluded and the average operator index was >90%, making the readings more accurate. New data on Asian population has been collected through this study.

6. Conclusion

Parameters of arterial stiffness vary with postural changes in hypertensive subjects on anti-hypertensive medications. The parameters of arterial stiffness reduce in sitting position compared to supine position. The significance of these variations is not well known but it may indicate reduction in cardiovascular events when patient is in sitting positon and may be on activity or exertion.

7. Conflict of Interest and Funding

There is no conflicts of interest in the manuscript, including financial, consultant, institutional and other relationships that might lead to bias or a conflict of interest. There is no funding support for this study.

References

1. Mitchell G, Hwang S, Vasan R, Larson M, Pencina M, Hamburg N et al. Arterial Stiffness and Cardiovascular Events: The Framingham Heart Study. Circulation. 2010; 121 (4): 505-511.
2. Laurent S, Cockcroft J, Van Bortel L, Boutouyrie P, Giannattasio C, Hayoz D et al. Expert consensus document on arterial stiffness: methodological issues and clinical applications. European Heart Journal. 2006; 27 (21): 2588-2605.
3. Laurent S, Boutouyrie P, Asmar R, Gautier I, Laloux B, Guize L et al. Aortic Stiffness Is an Independent Predictor of All-Cause and Cardiovascular Mortality in Hypertensive Patients. Hypertension. 2001; 37 (5): 1236-1241.
4. Safar M. Current Perspectives on Arterial Stiffness and Pulse Pressure in Hypertension and Cardiovascular Diseases. Circulation. 2003; 107 (22): 2864-2869.
5. Roman M, Devereux R, Kizer J, Lee E, Galloway J, Ali T et al. Central Pressure More Strongly Relates to Vascular Disease and Outcome Than Does Brachial Pressure: The Strong Heart Study. Hypertension. 2007; 50(1): 197-203.
6. Van Bortel L, Struijker-Boudier H, Safar M. Pulse Pressure, Arterial Stiffness, and Drug Treatment of Hypertension. Hypertension. 2001; 38(4): 914-921.
7. Oliver J. Noninvasive Assessment of Arterial Stiffness and Risk of Atherosclerotic Events. Arteriosclerosis, Thrombosis, and Vascular Biology. 2003; 23 (4): 554-566.
8. ESH/ESC Guidelines for the management of arterial hypertension. European Heart Journal. 2013; 34 (28): 2159-2219.
9. Agabiti-Rosei E, Mancia G, O'Rourke M, Roman M, Safar M, Smulyan H et al. Central Blood Pressure Measurements and Antihypertensive Therapy: A Consensus Document. Hypertension. 2007; 50 (1): 154-160.
10. Vrachatis D, Papaioannou T, Konstantopoulou A, Nasothimiou E, Millasseau S, Blacher J et al. Effect of supine versus sitting position on noninvasive assessment of aortic pressure waveform: a randomized cross-over study. Journal of Human Hypertension. 2013; 28 (4): 236-241.
11. Nürnberger J, Michalski R, Türk T, Saez A, Witzke O, Kribben A. Can arterial stiffness parameters be measured in the sitting position?. Hypertension Research. 2010; 34(2): 202-208.
12. Sule Ashish, Jun Du, Cheong Chin, Postural Changes in Measures of Arterial Stiffness in Hypertensive Subjects on Antihypertensive Drug Therapy: A Prospective, Pilot Study. Int J Angiol. 2017; 26 (02): 078-082.
13. Lee H, Oh B. Aging and Arterial Stiffness. Circulation Journal. 2010; 74(11): 2257-2262.
14. Ghiadoni L. The effects of antihypertensive drugs on arterial stiffness. Artery Research. 2016; 14: 1-5.

15. Koumaras C, Tzimou M, Stavrinou E, Griva T, Gossios T, Katsiki N et al. Role of Antihypertensive Drugs in Arterial 'De-Stiffening' and Central Pulsatile Hemodynamics. American Journal Cardiovascular Drugs. 2012; 12 (3): 143-156.
16. Tropeano AI, Boutouyrie P, Pannier B, Joannides R, Balkestein E, Katsahian S, et al. Brachial pressure-independent reduction in carotid stiffness after long-term angiotensin-converting enzyme inhibition in diabetic hypertensives. Hypertension 2006; 48: 80 – 86.
17. Ting CT, Chen CH, Chang MS, Yin FC. Short- and long-term effects of antihypertensive drugs on arterial reflections, compliance, and impedance. Hypertension 1995; 26: 524 – 530.
18. Topouchian J, Brisac AM, Pannier B, Vicaut E, Safar M, Asmar R. Assessment of the acute arterial effects of converting enzyme inhibition in essential hypertension: A double-blind, comparative and crossover study. J Hum Hypertens 1998; 12: 181-187.
19. Topouchian J, Asmar R, Sayegh F, Rudnicki A, Benetos A, Bacri AM, et al. Changes in arterial structure and function under trandolapril– verapamil combination in hypertension. Stroke 1999; 30: 1056-1064.
20. Asmar RG, London GM, O'Rourke ME, Safar ME. Improvement in blood pressure, arterial stiffness and wave reflections with a very low-dose perindopril/indapamide combination in hypertensive patient: A comparison with atenolol. Hypertension 2001; 38: 922-926.
21. Mahmud A, Feely J. Reduction in arterial stiffness with angiotensin II antagonist is comparable with and additive to ACE inhibition. Am J Hypertens 2002; 15: 321-325.
22. Lacourciere Y, Beliveau R, Conter HS, Burgess ED, Lepage S, Pesant Y, et al. Effects of perindopril on elastic and structural properties of large arteries in essential hypertension. Can J Cardiol 2004; 20: 795-799.
23. Mitchell GF, Arnold JM, Dunlap ME, O'Brien TX, Marchiori G, Warner E, et al. Pulsatile hemodynamic effects of candesartan in patients with chronic heart failure: The CHARM Program. Eur J Heart Fail 2006; 8: 191-197.
24. Mitchell GF, Dunlap ME, Warnica W, Ducharme A, Arnold JM, Tardif JC, et al. Long-term trandolapril treatment is associated with reduced aortic stiffness: The prevention of events with angiotensin converting enzyme inhibition hemodynamic substudy. Hypertension 2007; 49: 1271-1277.
25. Vaitkevicius P, Fleg J, Engel J, O'Connor F, Wright J, Lakatta L et al. Effects of age and aerobic capacity on arterial stiffness in healthy adults. Circulation. 1993; 88(4): 1456-1462.
26. Urbina E, Kimball T, Khoury P, Daniels S, Dolan L. Increased arterial stiffness is found in adolescents with obesity or obesity-related type 2 diabetes mellitus. Journal of Hypertension. 2010; 28(8):1692-1698.
27. Chirinos J, Kips J, Roman M, Medina-Lezama J, Li Y, Woodiwiss A et al. Ethnic Differences in Arterial Wave Reflections and Normative Equations for Augmentation Index. Hypertension. 2011; 57(6):1108-1116.
28. Kim G. Vascular Variation of PTT and the Vascular Characteristic Index According to the Posture Change. 2007 International Conference on Convergence Information Technology (ICCIT 2007), Gyeongju, 2007; 2426-2425.
29. Ghrist Dg. Variations in Pulse and Blood Pressure With Interrupted Change of Posture. Ann Intern Med. 1931; 4: 945-958.
30. Yves Yung et al. Reliability of oscillometric central blood pressure and wave reflection readings: effects of posture and fasting. Journal of Hypertension. 2015; 33(8): 1588-1593.
31. Alyssa Torjesen , Leroy L. Cooper , Jian Rong , Martin G. Larson et al. Relations of Arterial Stiffness With Postural Change in Mean Arterial Pressure in Middle-Aged Adults. Hypertension. 2017; 69(4): 685-690.
32. Yusuke Kobayashi, Tetsuya Fujikawa, Hideo Kobayashi, Koichiro Sumida, Shota Suzuki et al. Relationship between Arterial Stiffness and Blood Pressure Drop During the Sit-to-stand Test in Patients with Diabetes Mellitus. Journal of Atherosclerosis and Thrombosis. 2017; 24(2):147-156.
33. Stoner, Lee; Credeur, Daniel; Fryer, Simon et al. Reliability of pulse waveform separation analysis: effects of posture and fasting. Journal of Hypertension. 2017; 35(3): 501–505.
34. Bas van den Bogaard, Berend E. Westerhof, Hendrik Best, Shyrin C.A.T. Davis, Niels H. Secher, Bert-Jan H. van den Born & Johannes J. van Lieshout. Arterial wave reflection decreases gradually from supine to upright. Blood Pressure. 2011; 20(6): 370-375.