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Original Research

Assessment of changes in physiological and biochemical parameters of arterial stiffness

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ABSTRACT:
Background: High blood pressure represents one of the potent cardiovascular risk (CV) factor and a leading cause of total and CV mortality. The present study was conducted to assess changes in physiological and biochemical parameters of arterial stiffness. **Materials & Methods:** 80 healthy subjects were subjected to brachial systolic blood pressure (bSBP), brachial diastolic blood pressure, central systolic blood pressure (cSBP), central diastolic blood pressure (cDBP), heart rate, augmentation index (AIx[%]) and baPWV were recorded after 10 min of rest. Mean arterial pressure (MAP), pulse pressure (PP) and PP ratio (PPR) estimation. Serum samples were analysed to estimate OPG level and lipid profile. **Results:** Out of 80 patients, males were 50 and females were 30. The mean age in males was 45.1 years in females was 47.3 years, height (cm) was 164.2 in males and 151.2 in females. Weight (Kg) was 65.4 and 62.1, BMI (Kg/m2) was 24.2 and 27.5, baPWV (cm/s) was 1216.5 and 1289.3, augmentation index (%) was 67.3 and 84.2, central SBP (mmHg) was 118.2 and 126.2, central DBP (mm Hg) was 79.1 and 82.5, central pulse pressure (mm Hg) was 39.2 and 45.8, central MAP (mm Hg) was 90.1 and 95.2, brachial SBP (mm Hg) was 128.2 and 134.6, brachial DBP (mm Hg) was 78.2 and 79.0, brachial pulse pressure (mm Hg) was 49.1 and 52.6, brachial MAP (mm Hg) was 96.2 and 96.0, pulse pressure ratio was 1.3 and 1.1 in males and females respectively. Cholesterol (mg/dl) was 190.2 and 191.3, triglyceride (mg/dl) was 142.3 and 142.7, LDLc (mg/dl) was 122.7 and 120.3, HDLc (mg/dl) was 40.6 and 41.2, VLDLc (mg/dl) was 28.1 and 29.1 and osteoprotegerin (pg/ml) was 46.2 and 45 in males and females respectively. The difference was significant ($P<0.05$). **Conclusion:** Serum OPG level and serum TG levels emerged as major factors, which influence baPWV values in both genders.
Key words: Osteoprotegerin, Pulse pressure, Triglyceride

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INTRODUCTION

High blood pressure represents one of the potent cardiovascular risk (CV) factor and a leading cause of total and CV mortality. Recently published studies implicated a role of inflammation in the development of hypertension.[1] It has been further suggested that inflammation might be related to the stiffening of arteries, a condition associated with a normal ageing process or with premature vascular ageing, which occurs in hypertension and numerous metabolic disorders. Possible mechanisms between inflammation and arterial stiffness (AS) might be related to changes within the vessel wall such as e.g. inflammatory cell infiltration or vascular dysfunction.[2]

Ageing of the arterial system is accompanied by structural changes, including fragmentation and degeneration of elastin, increase in collagen, thickening of the arterial wall and progressive dilatation of arteries.[3] These changes result in a gradual stiffening of the vasculature and an increase in the velocity of the pressure wave as it travels down the aorta. In a normal elastic aorta, the pressure wave reflects from the periphery and returns to the heart during diastole.[4] This reflected wave helps augment pressure during diastole when coronary blood flow occurs. As the aorta stiffens, the velocity of the pressure wave increases and the reflected pressure wave eventually reaches the heart earlier i.e., at systole. It causes augmentation of systolic blood

pressure (SBP) and increased cardiac afterload.[5] The stiffening of the aorta, combined with the absence of diastolic augmentation from the reflected pressure wave, has the potential to reduce coronary filling. Arterial stiffening is associated with a widened pulse pressure (PP) that eventually progresses to isolated systolic hypertension, a condition affecting 30% of adults by the time they reach 80 years of age.[6] The present study was conducted to assess changes in physiological and biochemical parameters of arterial stiffness.

MATERIALS & METHODS

The present study was conducted among 80 healthy subjects without any cardiovascular or peripheral vascular disease of both genders. All were informed regarding the study and their written consent was obtained.

Data such as name, age, gender etc. was recorded. In all subjects, brachial systolic blood pressure (bSBP), brachial diastolic blood pressure, central systolic blood pressure (cSBP), central diastolic blood pressure (cDBP), heart rate, augmentation index (AIx[%]) and baPWV were recorded after 10 min of rest. Mean arterial pressure (MAP), pulse pressure (PP) and PP ratio (PPR) were derived from the recorded data. Serum samples were analysed to estimate OPG level and lipid profile. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Total- 80		
Gender	**Males**	**Females**
Number	50	30

Table I shows that out of 80 patients, males were 50 and females were 30.

Table II Anthropometric and clinical characteristics

Parameters	Males	Females	P value
Age (years)	45.1	47.3	0.05
Height (cm)	164.2	151.2	0.02
Weight (Kg)	65.4	62.1	0.01
BMI (Kg/m^2)	24.2	27.5	0.03
baPWV (cm/s)	1216.5	1289.3	0.12
Augmentation index (%)	67.3	84.2	0.01
Central SBP (mmHg)	118.2	126.2	0.04
Central DBP (mm Hg)	79.1	82.5	0.02
Central pulse pressure (mm Hg)	39.2	45.8	0.05
Central MAP (mm Hg)	90.1	95.2	0.04
Brachial SBP (mm Hg)	128.2	134.6	0.05
Brachial DBP (mm Hg)	78.2	79.0	0.15
Brachial pulse pressure (mm Hg)	49.1	52.6	0.03
Brachial MAP (mm Hg)	96.2	96.0	0.91
Pulse pressure ratio	1.3	1.1	0.19
Cholesterol (mg/dl)	190.2	191.3	0.80
Triglyceride (mg/dl)	142.3	142.7	0.92
LDLc (mg/dl)	122.7	120.3	0.81
HDLc (mg/dl)	40.6	41.2	0.15
VLDLc (mg/dl)	28.1	29.1	0.05
Osteoprotegerin (pg/ml)	46.2	45	0.71

Table II, graph I shows that mean age in males was 45.1 years in females was 47.3 years, height (cm) was 164.2 in males and 151.2 in females. Weight (Kg) was 65.4 and 62.1, BMI (Kg/m2) was 24.2 and 27.5, baPWV (cm/s) was 1216.5 and 1289.3, augmentation index (%) was 67.3 and 84.2, central SBP (mmHg) was 118.2 and 126.2, central DBP (mm Hg) was 79.1 and 82.5, central pulse pressure (mm Hg) was 39.2 and 45.8, central MAP (mm Hg) was 90.1 and 95.2, brachial SBP (mm Hg) was 128.2 and 134.6, brachial DBP (mm Hg) was 78.2 and 79.0, brachial pulse pressure (mm Hg) was 49.1 and 52.6, brachial MAP (mm Hg) was 96.2 and 96.0, pulse pressure ratio was 1.3 and 1.1 in males and females respectively. Cholesterol (mg/dl) was 190.2 and 191.3, triglyceride (mg/dl) was 142.3 and 142.7, LDLc (mg/dl) was 122.7 and 120.3, HDLc (mg/dl) was 40.6 and 41.2,

VLDLc (mg/dl) was 28.1 and 29.1 and osteoprotegerin (pg/ml) was 46.2 and 45 in males and females respectively. The difference was significant (P<0.05).

Graph I Anthropometric and clinical characteristics

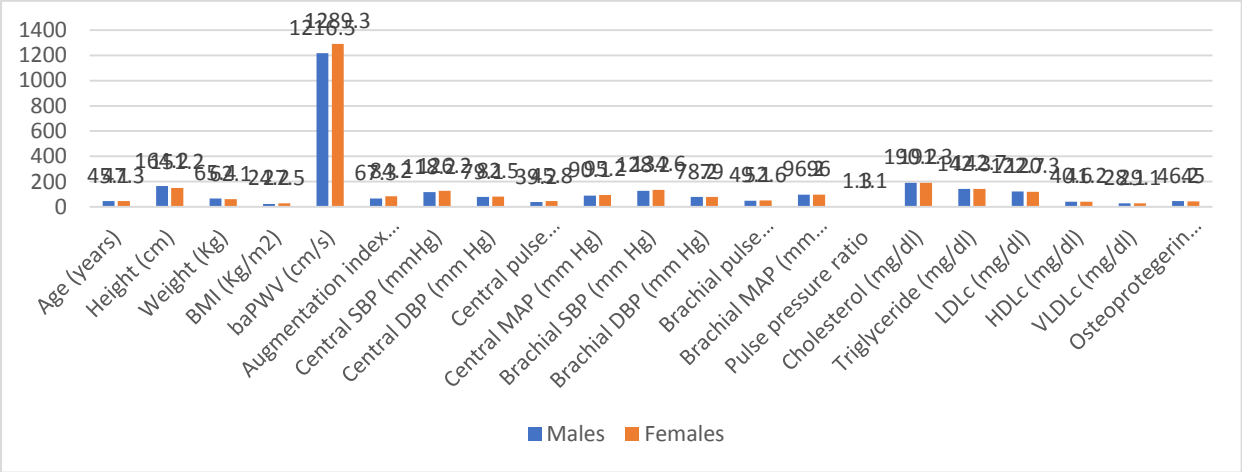

Table II Multiple regression analysis using brachial ankle pulse wave velocity

Variables	Unstandardised coefficients	t-values	P values
Serum triglyceride (mg/dl)	24.7	2.4	0.01
Serum VLDLc (mg/dl)	-123.5	-2.5	0.03
Serum osteoprotegerin (pg/ml)	2.4	-2.0	0.05

Table II shows that multiple regression analysis revealed that serum TG and OPG levels were strongly associated with baPWV. However, serum VLDLc was negatively associated with baPWV.

DISCUSSION

Arterial stiffness is an independent determinant of cardiovascular risk and a strong contributor to atherosclerosis. Increased arterial stiffness is associated with coronary artery disease, carotid atherosclerosis and peripheral arterial disease (PAD).[7] Aortic pulse wave velocity (aPWV) is a well-established marker of arterial stiffness and predicts cardiovascular events in general population and in patients with atherosclerosis. Osteopontin (OPN) is a glycoprotein that has been implicated in the pathogenesis of atherosclerosis.[8] The OPN is expressed in atherosclerotic plaques, and stimulates recruitment of macrophages and production of inflammatory cytokines. Serum OPN level is related to the presence and extent of coronary artery disease, and is an independent predictor of adverse cardiovascular events in patients with chronic stable angina.[9] The present study was conducted to assess changes in physiological and biochemical parameters of arterial stiffness.

In present study, out of 80 patients, males were 50 and females were 30. Kar et al[10] determined age-associated changes in physiological and biochemical parameters of arterial stiffness. Males had significantly higher value of height, weight and PPR than females. Females had significantly higher values of BMI, AIx (%), cSBP, cPP and brachial PP than males. Aged males had significantly higher AIx (%), cPP and brachial PP in comparison to younger males. Aged females showed significantly higher AIx (%), cPP, brachial PP, serum cholesterol, triglyceride (TG), low-density lipoprotein cholesterol (LDLc) and very LDLc (VLDLc) in comparison to younger females. Serum OPG level was found to be a major factor influencing the values of baPWV in both males and females. Other cardiovascular parameters such as cSBP, cDBP, cMAP, brachial SBP and MAP influenced baPWV values in both genders, but biochemical parameters such as serum cholesterol, LDLc influenced baPWV values in the male participants in the present study. Regression analysis revealed that serum TG and OPG levels were strongly associated with baPWV in both genders.

We found that mean age in males was 45.1 years in females was 47.3 years, height (cm) was 164.2 in males and 151.2 in females. Weight (Kg) was 65.4 and 62.1, BMI (Kg/m2) was 24.2 and 27.5, baPWV (cm/s) was 1216.5 and 1289.3, augmentation index (%) was 67.3 and 84.2, central SBP (mmHg) was 118.2 and 126.2, central DBP (mm Hg) was 79.1 and 82.5, central pulse pressure (mm Hg) was 39.2 and 45.8, central MAP (mm Hg) was 90.1 and 95.2 respectively. Zagura et al[11] evaluated the association between arterial stiffness, ASc, serum OPN and oxLDL in patients with symptomatic PAD, and in clinically healthy subjects. We studied 79 men with symptomatic PAD (mean age 64±7 years) and 84

healthy men (mean age 63±8 years). Calculation of the ASc was based on severity and location of atherosclerotic lesions in the arteries of the lower extremities. Aortic pulse wave velocity (aPWV) was evaluated by applanation tonometry using the Sphygmocor device. Serum OPN and oxLDL levels were determined by enzyme-linked immunosorbent assay. The aPWV (10±2.4 VS. 8.4±1.7), OPN 75 VS. 54.8; and oxLDL (67 (52.5–93.5) VS. 47.5 (37–65.5) were different for the patients and for the controls. In multiple regression models, aPWV was independently determined by ASc, log-OPN, log-oxLDL and estimated glomerular filtration rate in the patients and by log-OPN, log-oxLDL, age and heart rate in the controls. The independent relationship of a PWV with serum levels of OPN and oxLDL in the patients with PAD and in the controls indicates that OPN and oxLDL might influence arterial stiffening in patients with atherosclerosis and in clinically healthy subjects.

We found that brachial SBP (mm Hg) was 128.2 and 134.6, brachial DBP (mm Hg) was 78.2 and 79.0, brachial pulse pressure (mm Hg) was 49.1 and 52.6, brachial MAP (mm Hg) was 96.2 and 96.0, pulse pressure ratio was 1.3 and 1.1 in males and females respectively. Cholesterol (mg/dl) was 190.2 and 191.3, triglyceride (mg/dl) was 142.3 and 142.7, LDLc (mg/dl) was 122.7 and 120.3, HDLc (mg/dl) was 40.6 and 41.2, VLDLc (mg/dl) was 28.1 and 29.1 and osteoprotegerin (pg/ml) was 46.2 and 45 in males and females respectively. Vascular calcification, which leads to arterial stiffening, is an active process that resembles bone formation and is controlled by complex enzymatic and cellular pathways. It resembles more of orthotopic or skeletal bone formation. In this process, endochondral or intramembranous ossification occurs before mineralisation. Intramembranous ossification results from osteoblast-induced calcification of collagen extracellular matrix in the absence of collagen template.[12]

CONCLUSION

Authors found that Serum OPG level and serum TG levels emerged as major factors, which influence baPWV values in both genders.

REFERENCES

1. Banerjee D, Menon A, Kar M, Mahapatra SC. Effect of laboratory stressor on arterial compliance in young women. Indian J Physiol Pharmacol 2019;63:242-5.
2. Toto-Moukouo JJ, Achimastos A, Asmar RG, Hugues CJ, Safar ME. Pulse wave velocity in patients with obesity and hypertension. Am Heart J 1986;112:136-40.
3. Levenson J, Simon AC, Cambien FA, Beretti C. Cigarette smoking and hypertension, factors independently associated with blood hyperviscosity and arterial rigidity. Arteriosclerosis 1987;7:572-7.
4. Ai ZS, Li J, Liu ZM, Fan HM, Zhang DF, Zhu Y, et al. Reference value of brachial-ankle pulse wave velocity for the eastern Chinese population and potential influencing factors. Braz J Med Biol Res 2011;44:1000-5.
5. Wilkinson IB, Mohammad NJ, Tyrrell S, Hall IR, Webb DJ, Paul VE, et al. Heart rate dependency of pulse pressure amplification and Arterial Stiffness. Am J Hypertens 2002;15:24-30.
6. Chung JW, Lee YS, Kim JH, Seong MJ, Kim SY, Lee JB, et al. Reference values for the augmentation index and pulse pressure in apparently healthy Korean subjects. Korean Circ J 2010;40:165-71.
7. Gatzka CD, Kingwell BA, Cameron JD, Berry KL, Liang YL, Dewar EM, et al. Gender differences in the timing of arterial wave reflection beyond differences in body height. J Hypertens 2001;19:2197-203.
8. Westerhof N, O'Rourke MF. Haemodynamic basis for the development of left ventricular failure in systolic hypertension and for its logical therapy. J Hypertens 1995;13:943-52. 21.
9. Szulc P, Hofbauer IC, Heufelder AE, Roth S, Delmas PD. Osteoprotegerin serum levels in men: Correlation with age, estrogen, and testosterone status. J Clin Endocrinol Metab 2001;86:3162-5.
10. Kar M, Panigrahi M, Mahapatra SC. Age-associated changes in physiological and biochemical arterial stiffness markers in apparently healthy individuals. Indian Journal of Physiology and Pharmacology. 2020 Jul 31;64(2):129-36.
11. Zagura M, Kals J, Serg M, Kampus P, Zilmer M, Jakobson M, Unt E, Lieberg J, Eha J. Structural and biochemical characteristics of arterial stiffness in patients with atherosclerosis and in healthy subjects. Hypertension Research. 2012 Oct;35(10):1032-7.
12. Mangan SH, Campenhout AV, Rush C, Golledge J. Osteoprotegerin upregulates endothelial cell adhesion molecule response to tumor necrosis factor-alpha associated with induction of angiopoietin-2. Cardiovasc Res 2007;76:494-505.