Journal of Medical Diagnostic Methods

Grover-Páez, et al., J Med Diagn Meth 2015, 4:3
DOI: 10.4172/2168-9784.1000.181

Short Communication Open Access

Ankle-Brachial Index and Brachial-Ankle Pulse Wave Velocity in a Mexican Population of Healthy Individuals: A Reproducibility Research Study

Grover-Páez Fernando*, Carlos GRB, Adrián SGA, Assen OI, Sylvia ETS, David CM and Ernesto GCM

Institute of Clinical and Experimental Therapeutics, Physiology Department, Department of physiology, University Center for Health Sciences, University of Guadalajara, México

***Corresponding author**: Fernando Grover-Páez, Institute of Clinical and Experimental Therapeutics, Physiology Department, Department of physiology, University Center for Health Sciences, University of Guadalajara, México, Tel: 52110585200, extn. 34215; E-mail: fgroverp@hotmail.com

Received date: Aug 31, 2015, **Accepted date:** Sep 14, 2015, **Published date:** Sep 21, 2015

Abstract

Background: Ankle-brachial systolic pressure index, reflect arterial hemodynamics in lower extremity and therefore indicates the presence of peripheral arterial disease. On the other hand, an emerging method for assessing arterial stiffness is brachial-ankle pulse wave velocity. Automated devices, such as the "Vascular Profiler 1000" (VP1000) (Omron®, Kyoto, Japan), are currently available for measuring not only the brachial-ankle pulse wave velocity but also the ankle-brachial index, proving their utility in the diagnosis of peripheral arterial disease.

Objective: This study assessed the agreement and reproducibility of non-invasive measurement of brachial-ankle pulse wave velocity (baPWV) and the ankle-brachial index (ABI) with the OMRON® VP1000 device, in a Mexican population of healthy individuals.

Methods: The cross-sectional study was carried out in 36 healthy subjects (20 men and 16 women; average age was 20.6 ± 1.6 years, average BMI 23.5 ± 3.5 kg/m^2, average waist circumference 82.5 ± 9.3 cm kg/m^2) from Guadalajara, México. The baPWV and ABI were measured with the VP1000 device, and all values were expressed as the average ± SD. The correlation between the first and second measurements was analyzed using Pearson's correlation coefficient and the Bland Altman method. All p-values were two-tailed, and $p<0.05$ was accepted as significant.

Results: The right and left baPWV showed good correlation between the first and second measurements (r^2 Pearson=0.810, $p<0.001$ and r^2 Pearson=0.831, $p<0.001$). The arterial ABI also showed good correlation between the first and second measurement (r^2 Pearson=0.730, $p<0.001$ and r^2 Pearson=0.599, $p<0.001$). The Bland-Altman plot of the first and second baPWV and ABI measurements demonstrated good agreement (mean difference -4.3 ± 39.43 cm/s and -0.0071 ± 0.43, respectively).

Conclusion: The results obtained with the OMRON® VP1000 device, demonstrate high and significant correlation, as well as good agreement, between the first and second baPWV arterial stiffness and ABI values.

Keywords: Arterial stiffness; Peripheral arterial disease; Ankle-brachial index; Brachial-ankle pulse wave velocity; Mexican population; Healthy individuals

Abbreviation:

baPWV; Brachial-Ankle Pulse Wave Velocity; ABI: Ankle-Brachial Index

Introduction

Ankle-brachial systolic pressure index (ABI), reflect arterial hemodynamics in lower extremity. A reduced value of these measurements is caused by hemodynamically significant arterial stenosis and therefore indicates the presence of peripheral arterial disease (PAD). ABI ≤0.90 in symptomatic individuals, for example, is approximately 95% sensitive in detecting arteriogram-positive PAD and almost 100% specific in identifying healthy individuals [1]. Because of their predictive capability and noninvasiveness, these measurements are recommended for screening and determining PAD in many clinical settings [2].

On the other hand, arterial stiffness is currently one of the determining factors in the augmentation of pulse and systolic pressure in the aging population and is an independent cardiovascular risk marker with better predictive value than any of the classic risk factors. The carotid-femoral pulse wave velocity (cfPWV) is considered the gold standard for assessing arterial stiffness [3]. Due to the existence of sundry devices and different methods for measuring arterial stiffness, such as pulse wave velocity (PWV), assessing and comparing them to establish their reference values is convenient.

An emerging method for assessing arterial stiffness is brachial-ankle pulse wave velocity (baPWV). Studies in the Asian population have shown a positive correlation between baPWV and cfPWV (r=0.73) with similar points of association with cardiovascular risk factors and clinical events [4]. In addition, a good correlation has been shown with the Framingham Risk Score (FSR; r=0.53, p<0.01) [5]. Due to the simplicity of the technique, baPWV is perfect for studying the general

Citation: Grover-Páez F, Carlos GRB, Adrián SGA, Assen OI, Sylvia ETS, et al. (2015) Ankle-Brachial Index and Brachial-Ankle Pulse Wave Velocity in a Mexican Population of Healthy Individuals: A Reproducibility Research Study. J Med Diagn Meth 4: 181. doi: 10.4172/2168-9784.1000.181

population and may be applied in daily clinical practice, allowing cut-off points to be established for a specific population. Automated devices, such as the "Vascular Profiler 1000" (VP1000) (Omron®, Kyoto, Japan), are currently available for measuring not only the baPWV, but also the ankle-brachial index (ABI), proving their utility in the diagnosis of peripheral arterial disease (PAD) [6]. No research in the scientific literature currently addresses the reproducibility of measurements with this device, particularly in a Latin American population without cardiovascular risk factors. Therefore, this study was performed to assess the validity and reproducibility of non-invasive measurement of the baPWV and ABI with such a device in healthy individuals in Mexico.

Material and Methods

A total of 36 healthy subjects (20 men and 16 women) from the metropolitan area of Guadalajara, Jalisco, Mexico were examined. The baPWV and ABI were measured with the VP1000 device. Subjects were asked to refrain from drinking alcohol and caffeinated drinks 12 hours before the examination. Prior to the measurement, the subjects were asked if they needed to urinate and to not speak or cross their legs during the measurement. Patients were in the supine position at rest for 15 minutes prior to beginning the measurement. Four pneumatic bracelets were placed on each extremity and the brachial circumference of each arm measured using a medium bracelet for patients with a circumference between 20 and 32 cm and a large bracelet for circumferences between 30 and 38 cm. For ankles, a standardized measure of 16-33 cm was used. The bracelets were connected to a sensor determining the pulse waveform, in addition to an oscillometric pressure sensor that measures blood pressure. Pulse waves were analyzed using a semiconductor pressure sensor with an acquisition frequency of 1,200 Hz. Electrodes were placed in the sternal border at the level of the fourth intercostal space. Measurements were performed in a well illuminated room with a calm environment and average temperature of 25°C. The same device simultaneously measures the peripheral blood pressure in both arms and ankles, and the ABI was calculated as the relationship between the minimum ankle systolic pressure divided by the maximum arm systolic pressure. Two measurements were performed to calculate the reproducibility of the OMROM® VP1000 device with a time difference of 60 seconds.

All values are expressed as an average ± the standard deviation (SD). The correlation between the first and second measurements was analyzed using Pearson's correlation coefficient. All p-values were two-tailed, and $p<0.05$ was accepted as significant.

Results

The average age of the 36 participants was 20.6 ± 1.6 years, average BMI 23.5 ± 3.5 kg/m^2, and average waist circumference 82.5 ± 9.3 cm. Two consecutive measurements were obtained to estimate the stiffness and arterial obstruction variables: peripheral systolic blood pressure (112.74 ± 11.17 and 111.03 ± 10.24 mmHg), peripheral diastolic blood pressure (62.26 ± 7.67 and 59.46 ± 7.02 mmHg), right baPWV (999.77 ± 114.76 and 979.17 ± 151.74 m/s), left baPWV (1003.34 ± 128.23 and 1000.40 ± 117.87 m/s), right ABI (1.06 ± 0.07 and 1.08 ± 0.09), and left ABI (1.03 ± 0.07 and 1.03 ± 0.07). The correlation between the first and second peripheral systolic blood pressure measurement was significant (r^2 Pearson=0.916, $p<0.001$). The first and second peripheral diastolic blood pressure measurements also correlated significantly (r^2 Pearson=0.785, $p<0.001$). The right and left baPWV showed good correlation between the first and second measurements (r^2 Pearson=0.810, $p<0.001$ and r^2 Pearson=0.831, $p<0.001$). The arterial ABI also showed good correlation between the first and second measurement, though to a lesser degree on the left side (r^2 Pearson=0.730, $p<0.001$ and r^2 Pearson=0.599, $p<0.001$). The Bland-Altman plot of the first and second baPWV measurements (Figure 1) demonstrates good agreement (mean difference -4.3 ± 39.43 cm/s) and no systematic bias. The Bland-Altman plot of the first and second ABI measurements (Figure 2) also demonstrates good agreement (mean difference -0.0071 ± 0.043) and no systematic bias.

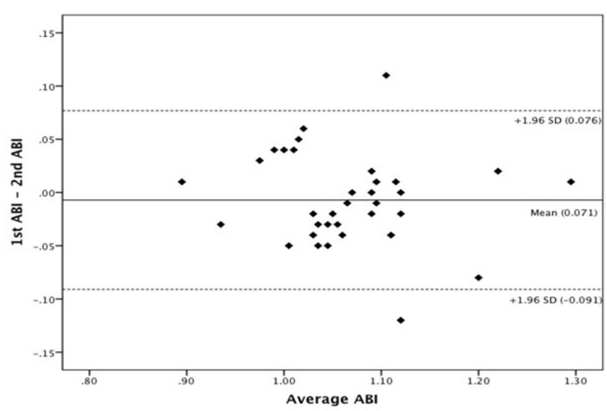

Figure 1: Average (x) and standard deviation (y) of the first and second brachial-ankle pulse wave velocity (baPWV) measurements.

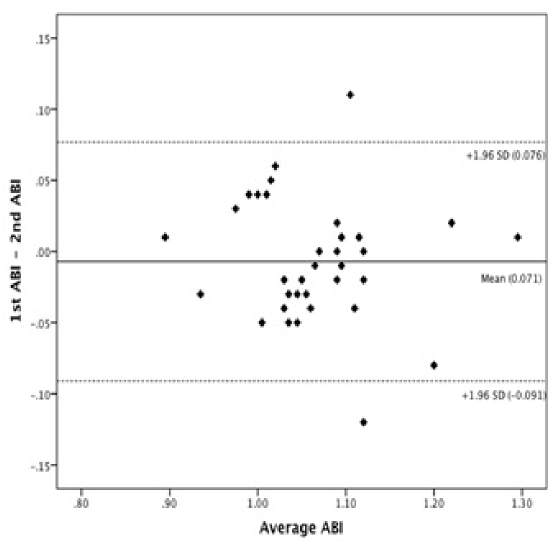

Figure 2: Average (x) and standard deviation (y) of the first and second ankle-brachial index (ABI) measurements.

Discussion

In this study, predictive values were not estimated; only the reproducibility of different measurements was assessed. Notably, this is the first study of healthy individuals in the Mexican population to report the correlation and agreement of baPWV and ABI values. The semi-automated OMRON® VP1000 device is simple to use and not operator-dependent, guaranteeing high reliability and reproducibility in the results. Therefore, such measurements can be used as reference values for future projects.

Conclusion

The results obtained with the OMRON® VP1000 device demonstrate high and significant correlation, as well as good agreement, between the first and second baPWV arterial stiffness and ABI values. Peripheral arterial pressure values calculated at the brachial level (systolic and diastolic) also demonstrated good reproducibility.

References

1. Norgren L, Hiatt WR, Dormandy JA (2007) TASC II Working Group. Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II). Eur J Vasc Endovasc Surg 33: S1-S75.
2. Jude EB, Eleftheriadou I, Tentolouris N (2010) Peripheral arterial disease in diabetes a review. Diabet Med 27: 4-14.
3. Laurent S, Cockcroft J, Van Bortel L, Boutouyrie P, Giannattasio C, et al. (2006) For the European Network for Non-invasive Investigation of Large Arteries. Expert consensus document on arterial stiffness: methodological issues and clinical applications. Eur Heart J 27: 2588-2605.
4. Tanaka H, Munakata M, Kawano Y, Ohishi M, Shoji T, et al. (2009) Comparison between carotid-femoral and brachial-ankle pulse wave velocity as measures of arterial stiffness. J Hypertens 27: 2022-2027.
5. Mitani S, Fujita M, Shigeta M, Kuriyama N, Ozaki E, et al. (2012) Determinants of brachial-ankle pulse wave velocity in a Japanese population: a cohort study. Blood Press 21: 338-44.
6. Norgren L, Hiatt WR, Dormandy JA (2007) Inter-society consensus for the management of peripheral arterial disease. Int Angiol 26: 81-157.