



Assessment of Endothelial Function and Arterial Stiffness in Type 2 Diabetic Older Adults

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Introduction

Type 2 Diabetes (T2D) is a metabolic disease that reduces the body's ability to regulate blood glucose, leading to vascular dysfunction and increased cardiovascular risk. The progressive arterial stiffness associated with aging is a predictor of cardiovascular disease and is accelerated by T2D. Arterial stiffness is preceded by dysfunction of the endothelial cells. When the endothelial dysfunction is developed, the artery is less compliant to the volume of blood traveling through it. A technique for measuring endothelial function is called flow-mediated dilation (FMD), which evaluates the vasodilatory capacity of an artery, mainly the brachial artery, in response to increased blood flow. One way to recognize how compliant the arteries are is to measure the transit time of the pulse between two arterial segments, this is called the pulse wave velocity (PWV). The PWV from the carotid to femoral artery (cfPWV) is considered the most important segment as it indirectly measures the stiffness of the aorta.

Purpose

To determine if there is greater endothelial dysfunction in T2D compared to non-diabetic older adults using measurements of brachial artery FMD and aortic stiffness (cfPWV).

Materials & Methods

Participants

Subject Characteristics			
	Type II Diabetics (n = 7)	Non-Diabetics(n = 7)	P value
Age (yr)	74 ± 9.9	69.4 ± 7.8	0.343
Height (m)	1.65 ± .07	1.66 ± .10	0.806
Weight (kg)	76.8 ± 7.3	73.8 ± 18.5	0.969
BMI (kg/m ²)	28.3 ± 3.4	26.3 ± 3.7	0.315
WC (cm)	95.8 ± 11.8	94.3 ± 14.4	0.843
MVC (kg)	36.6 ± 8.4	37.8 ± 9	0.788
Glucose	153.7 ± 28.9	102.4 ± 11.1	<0.001
cfPWV	10.2 ± 2.3	7.4 ± 1.9	0.035
braFMD	4.5 ± 0.9	4.3 ± 0.9	0.630
SBP (mmHg)	136.9 ± 19.7	128 ± 7.4	0.287
DBP (mmHg)	70.7 ± 10.1	74.6 ± 3.3	0.356
MAP (mmHg)	92.7 ± 12.5	92.4 ± 3.4	0.955
PP (mmHg)	66.1 ± 12.7	53.4 ± 8.2	0.047

Abbreviations: BMI, Body Mass Index; WC, Waist Circumference; MVC, Maximum Voluntary Contraction; cfPWV, carotid-femoral Pulse Wave Velocity; braFMD, brachial artery Flow Mediated Dilation; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; MAP, Mean Arterial Pressure; PP, Pulse Pressure.

Procedure

FMD and cfPWV analyses will be performed on 14 individuals (n = 7 T2D, 74 ± 4 years, n = 7 ND, 69 ± 3 years). Video recordings of the brachial artery (diameter and blood velocity) were captured using ultrasonography. Baseline diameter are recorded prior to arterial occlusion with a rapid-inflating cuff (250 mmHg) positioned on the forearm distal to the ultrasound probe. The cuff was inflated for 5 minutes and the change in arterial diameter post-ischemia was analyzed. Distance from the carotid to femoral arteries was measured and the transit time of the pulse wave was assessed via applanation tonometry techniques to determine cfPWV

Figure 1

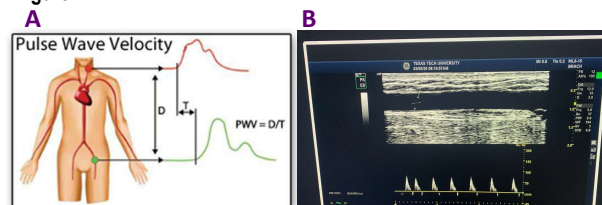
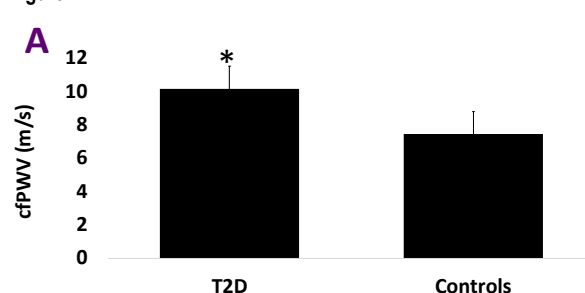


Figure 1: The cfPWV (A) was measured by dividing the distance by the time delay between the carotid and femoral pulse pressures. Transverse ultrasound image (B) of the brachial artery was put through an edge detection software to measure post-ischemia dilation.

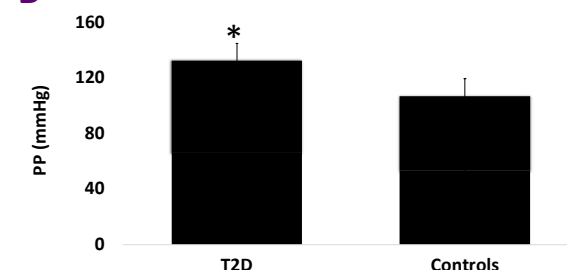
Results

cfPWV measurements were found to be significantly higher in those with T2D (10.2 ± 2.3 m/s) compared to ND (7.4 ± 1.9 m/s, $p = 0.035$). No significant difference of braFMD was found between groups. PP was significantly greater in the T2D (66.1 ± 12.7) compared to ND (53.4 ± 8.2 , $p = 0.047$). No correlations were found between PP and cfPWV.

Figure 2



B



C

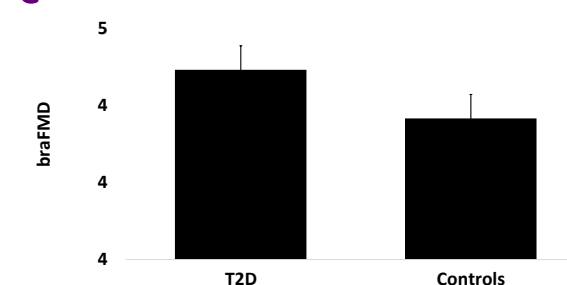


Figure 2: The comparison between (A) carotid femoral pulse wave velocity (cfPWV); (B) pulse pressure (PP); (C) brachial flow-mediated dilation (braFMD) in type 2 diabetes patients (T2D) and controls. Values are presented as mean ± standard error. Time effect for all was * $p < 0.05$ T2D vs. Controls.

Conclusion

Older adults with T2D have a greater cfPWV and PP compared to ND, but no significant difference was found between braFMD measurements. These findings demonstrate the damage increased glucose in the blood stream has on arterial health as well as how it contributes to increased cardiovascular risk factors. In conclusion cfPWV is greater in older adults with T2D compared to healthy adults, but braFMD results were inconclusive.

Limitations

In older women, the impairment of glucose is associated with high PP. As this study mostly consisted of women, the extrapolation of its results to men is likely inaccurate. The present study was limited by a relatively small sample size for evaluation of sex-differences in T2D patients.

Acknowledgments

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