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PUBTEXTO

Close Relationship of Diabetes and Hypertension for Arterial Sclerosis (AS) By Brachial-Ankle Pulse Wave Velocity (baPWV)

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Abstract

Mutual relationship of diabetes, hypertension, dyslipidemia, atherosclerotic cardiovascular disease (ASCVD) and cerebral vascular accident (CVA) would be often observed. They have common etiological aspects, including obesity, insulin resistance, oxydative stress and inflammation. As to further evaluation, arterial stiffness (AS) has been studied for measuring brachial-ankle pulse wave velocity (baPWV). Diabetic patients show higher incidence of carotid stenosis and peripheral artery disease (PAD). Recent study showed significantly higher hazard ratios (HR) of diabetes onset for higher baPWV and blood pressure (BP). HR was 1.48 for only high baPWV, 2.11 for only high BP and 2.42 for both high values, respectively.

Keywords: Brachial-Ankle Pulse Wave Velocity (baPWV); Arterial Stiffness (AS); Atherosclerotic Cardiovascular Disease (ASCVD); Type 2 Diabetes (T2D) Hypertension

Commentary

For decades, diabetes mellitus has been a crucial global health and social problem associated with high disability and morbidity. The number of diabetic patients are increasing rapidly [1]. According to WHO, the estimated diabetic prevalence was 9.3% for adults in 2019. It seems to reach 10.9% in 2045 because of inadequate healthy lifestyle and aging population worldwide [2]. Regarding applicable clinical management, American Diabetes Association (ADA) presented the standard guideline in January 2022 [3]. For middle to higher aged patients, glycemic control would be required for protecting the development of macro-/micro- angiopathy [4]. Diabetes may cause multiple organ damage, which leads to various events [5]. Mutual relationship of diabetes and other non-communicable diseases (NCDs) has been crucial, including hypertension, dyslipidemia, atherosclerotic cardiovascular disease (ASCVD) and cerebral vascular accident (CVA) [6].

Diabetes and hypertension often coexist in a subject. Both have common etiological aspects, including obesity, insulin resistance, oxydative stress and inflammation [7]. From some studies, hypertensive cases are likely to develop diabetes more than normotensive cases [8]. Thus, hypertension seems to increase the strong risk for diabetes. Furthermore, arterial stiffness (AS) becomes the risk of diabetes and insulin resistance. AS has common perspective in the background of hypertensive patients [9]. Regarding adequate biomarker for AS, brachial-ankle pulse wave velocity (baPWV) has been widely used for years. Before fasting plasma glucose (FPG) increases, baPWV has been already elevated [10]. Consequently, both of AS and hypertension may become risk factors of diabetes.

For diabetes or prediabetes, the presence of hypertensive target organ damage was investigated [11]. The results showed that hypertensive influence would increase the risk of diabetes [12]. Consequently, preclinical diabetes may attribute to the development of hypertension and vascular damage [13]. As to adequate index for adverse clinical events, AS seems to be better marker than blood pressure (BP) [14]. However, some discussions have been found concerning the priority of AS or BP for predicting the onset of diabetes [15].

Type 2 diabetes (T2D) has correlated with elevated risk for atherosclerosis [16]. In comparison with non-diabetes, T2D shows higher incidence of carotid stenosis and peripheral artery disease (PAD) [17]. Especially, acute hyperglycemia plays a crucial role for development of ASCVD than fasting situation. Then, 60-min post-prandial glucose during OGTT can be useful for identifying subjects who are higher risk of T2D and ASCVD [18]. For some reports, 60min hyperglycemia would correlate with carotid atherosclerosis in early period [19]. From some mega studies, 60min blood glucose would be a crucial predictor of CV events for long term [20].

The value of arterial elasticity is recognized as early parameter of atherosclerosis. Brachial-ankle pulse wave velocity (baPWV) means systemic arterial elasticity that is measured by the analyses of tibial and brachial arterial waves. The exam of baPWV is used for easy procedure, which has been a significant predictor of cardiovascular events. As arterial stiffness increases, insulin resistance and incremental glucose peak increase [21]. According to some investigations, 60min post-prandial glucose showed significant relationship with baPWV of normal glucose tolerance (NGT), hypertension or healthy subjects [22]. In recent study, relationship between 1-hour glucose and baPWV was investigated [23]. For the protocol, subjects included 57 normal subjects, 38 prediabetes and 30 T2D. Their results of baPWV were 1368, 1429 and 1502 cm/s, respectively. The baPWV values correlated with age, systolic/diastolic blood pressure (SBP/DBP), fasting plasma glucose ($r = 0.213$, $p = 0.017$) and 1-h plasma glucose levels from the OGTT ($r = 0.407$, $p < 0.001$) [23].

According to latest report, both presence of hypertension and arteriosclerosis are associated with increased risk of developing diabetes [24]. As a prospective cohort study, 11,156 subjects were analyzed for their baPWV. Based on both results of baPWV and blood pressure (BP), participants were divided into 4 groups, and the developing risk of diabetes was studied. Four groups were i) normal baPWV and normal BP (39.4%), ii) high baPWV and normal BP (24.2%), iii) normal baPWV and high BP (7.5%), iv) high baPWV and high Bp (28.9%). Those who have history of diabetes at baseline were excluded from this study. As a result, 768 cases develop diabetes during follow up 6.2 years in median. After adjusting some factors (age, gender, BMI, eGFR, lipid profile, CRP, heart rate, etc.), both baPWV and BP became within the standard values [24]. In contrast, the other three groups showed significantly higher hazard ratios (HR) of diabetes onset, as follows. HR is 1.00 for both normal values of baPWV and BP. The group with normal baPWV and high BP is HR 1.48, the group with high baPWV and normal BP is HR 2.11 and the group with both high data is HR 2.42. For risk factor-based model, predictive ability was analyzed using diabetes, hypertension and baPWV. Then, the evaluation by baPWV showed better predictive ability than hypertension for the development of diabetes.

Consequently, arteriosclerosis prevention strategies may contribute the prevention of the onset of diabetes. As to the relevance of this prospective study, diabetes has been associated with both of hypertension and AS. Furthermore, AS becomes better predictive ability for diabetes onset, compared to hypertension. This report showed the novelty perspective that elevated AS may be involved in development of diabetes, and combined control of AS and hypertension may decrease the diabetes risk.

Some limitation would be present for medical area of diabetes, hypertension, BP, AS, ASCVD and baPWV. Patients show heterogeneous and combined situations. Then, it includes simultaneously multiple factors to be analyzed. In summary, diabetes has close mutual relationship with hypertension and ASCVD by some biomarkers of BP, AS, baPWV. Further research development will be expected in the future.

Conflict of Interest

The authors declare no conflict of interest.

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