Type 2 Diabetes Mellitus and Hypertension: An Update

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KEYWORDS

• Diabetes • Hypertension • Cardiovascular disease • Chronic kidney disease
• Renin-angiotensin-aldosterone system • Sympathetic nervous system

KEY POINTS

- Patients with hypertension and type 2 diabetes are at increased risk of cardiovascular and chronic renal disease.
- Factors involved in the pathogenesis of both hypertension and type 2 diabetes include inappropriate activation of the renin-angiotensin-aldosterone system, oxidative stress, inflammation, impaired insulin-mediated vasodilatation, augmented sympathetic nervous system activation, altered innate and adaptive immunity, and abnormal sodium processing by the kidney.
- The renin-angiotensin-aldosterone system blockade is a key therapeutic strategy in the treatment of hypertension in type 2 diabetes.
- Emerging therapies include renal denervation and carotid body denervation.

INTRODUCTION

Hypertension (HTN) is present in more than 50% of patients with diabetes mellitus (DM) and contributes significantly to both microvascular and macrovascular disease in DM (**Fig. 1**).[1–4] The risk for cardiovascular disease (CVD) is 4-fold higher in patients

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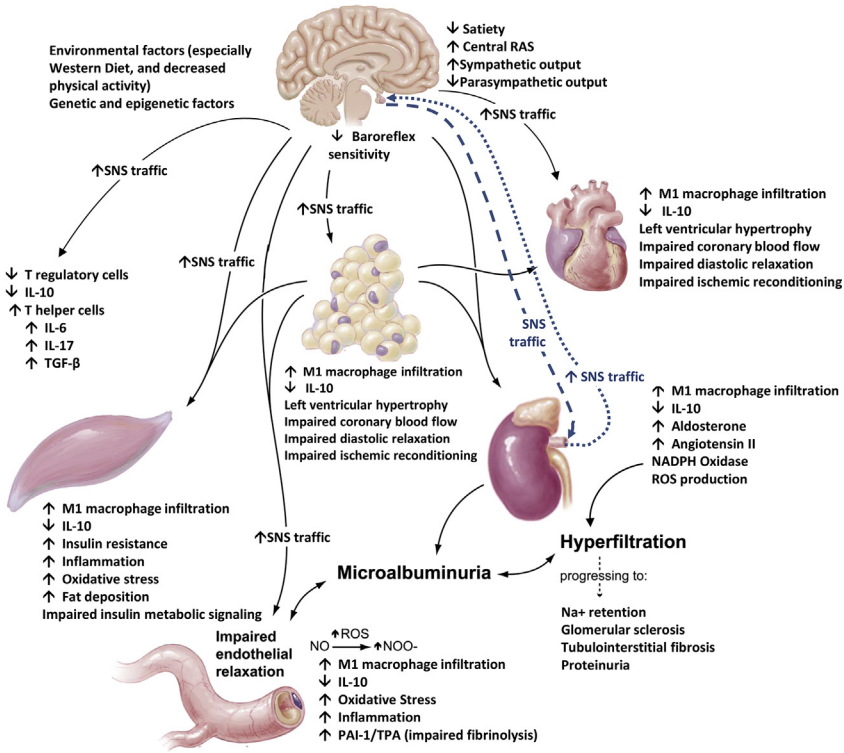

Fig. 1. Systemic and metabolic factors that promote coexistent diabetes mellitus, hypertension, cardiovascular, and chronic kidney disease. IL-10, interleukin 10; NADPH, nicotinamide adenine dinucleotide phosphate oxidase; PAI-1, plasminogen activator inhibitor 1; RAS, renin-angiotensin system; ROS, reactive oxygen species; SNS, sympathetic nervous system; TGF, tumor growth factor; TPA, tissue plasminogen activator. (*Adapted from* Sowers JR. Recent advances in hypertension. Diabetes Mellitus and Vascular Disease. Hypertension 2013;61:94; with permission.)

with both DM and HTN compared with the normotensive nondiabetic controls.[4,5] To this point, a meta-analysis of 102 prospective studies involving 698,782 individuals found that DM is responsible for approximately a 2-fold increased risk for coronary heart disease, stroke, and deaths from cardiovascular cause, including heart failure, cardiac arrhythmia, sudden death, hypertensive disease, and aortic aneurysms.[6] These data suggest that about 10% of vascular deaths in industrialized countries can be attributed to DM, and this burden will further increase as the incidence of diabetes continues to increase.[6] In the Framingham Heart Study, DM was associated with a 2-fold to 4-fold increased risk of myocardial infarction (MI), congestive heart failure, peripheral arterial disease, stroke, and death.[7] Furthermore, a more recent analysis of the Framingham data showed that the population with HTN at the time of DM diagnosis had higher rates of mortality for all causes (32 vs 20 per 1000 person-years; $P<.001$) and cardiovascular events (52 vs 31 per 1000 person-years; $P<.001$) compared with normotensive subjects with DM, thus suggesting that much of this excess risk is attributable to coexistent HTN.[8]